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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

APR 10 2002

GEOTHERMAL WELL DRILLING PERMIT

Kapoho State 12 (KS-12)
Kapoho, Puna, Hawaii

TO: Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778-0030
(808) 965-6233

Your application dated March 15, 2002, for a permit to drill a geothermal well on land located within the Kapoho Section of the Kilauea Lower East Rift Geothermal Resource Subzone and covered under the State of Hawaii, Geothermal Resource Mining Lease No. R-2 is approved.

Well Designation:	Kapoho State 12 (KS-12)
Location:	TMK 1-04-01:19, Kapoho, Puna, Hawaii (Well Pad B)
Well Coordinates:	154° 53' 38" W 19° 28' 48" N
State Geothermal Mining Lease:	R-2
Leased to:	Kapoho Land Partnership
Subleased to:	Puna Geothermal Venture
Operator:	COSI Puna, Inc.
Ground Elevation:	610' Above Mean Sea Level
Projected Depth:	9,000' +/- True Vertical Depth

Approval is granted in accordance with the Department of Land and Natural Resources' (Department's) Administrative Rules, Chapter 13-183, Hawaii Administrative Rules (HAR), and under the following conditions:

(1) All work shall be performed in accordance with the permission and terms of the occupiers of the land, the Drilling and Completion Plan submitted with your application, the Department's Administrative Rules (Chapters 13-183 and 13-184, HAR), and all other applicable Federal, State, and County laws, ordinances, rules and regulations;

APR 10 2002

(2) The permittee, its successors and assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury and death arising out of any act or omission of the applicant, assigns, officers, employees, contractors and agents under this permit or relating to or connected with the granting of this permit;

(3) The permittee shall observe and comply with all valid requirements of County, State, and Federal authorities and regulations to the land and permittee's operations including, but not limited to, all water and air pollution control laws and those relating to the environment;

(4) The well and bottom-hole location shall be located more than 100 feet from the outer boundary of the parcel of land on which the well is situated, or more than 100 feet from a public road, street or highway dedicated prior to the commencement of drilling, unless modified by the Chairperson upon request;

(5) The permittee shall notify the Department, in writing, of the date of the start of the drilling operations;

(6) Prior to drilling, the permittee shall submit to the Department the bottom-hole target location and the direction of any proposed deviation;

(7) All Blow-Out Prevention Equipment (BOPE) and cemented casing strings shall be pressure tested before commencing any other operations on the well. The minimum test pressures shall be approximately one-third of the casing internal yield pressure rating, providing the test pressure shall not be less than 600 psig nor greater than 2,500 psig, and shall be applied for a period of thirty minutes. The results of the pressure tests shall be reported on forms provided by the Department;

(8) Class "G" cement shall be used in the casing cementing operations and shall contain a high temperature resistant admix;

(9) A real time monitoring device shall be installed for the driller and a pit alarm system shall be included with this monitoring device. All toolpushers, drillers, and derrickmen shall be schooled in the use of the recommended monitoring equipment;

(10) If changes to the proposed drilling programs are contemplated, the permittee shall obtain the Chairperson's approval before executing such changes;

(11) When drilling has reached a depth of not more than 50 feet below sea level, the Department's representative shall be notified, with reasonable time allowed for travel to the site, to witness the retrieval of a representative ground water sample and the measurement of the static water level. The permittee shall have the sample analyzed by an independent laboratory and have the results submitted to the Department;

(12) A pressure and temperature survey, to inspect the mechanical integrity of the well, shall be performed after the well has been drilled to total depth, and before commencing the well cleanout flow or injection test;

(13) During the use of the well for testing, monitoring, production and/or injection purposes, the well and site shall be properly maintained until the well is plugged and abandoned in accordance with the Department's Administrative Rules, Chapter 13-183, HAR;

(14) The permittee shall submit to the Chairperson, the results of any exploration, all drilling and testing records, down-hole surveys of the well, bottom-hole location, date of completion, and a survey of the well location and elevation above mean sea level taken by a Hawaii licenced surveyor within six months after completion of the well;

(15) A well completion report, an as-built drawing of the well, and the location of the well plotted on a U.S.G.S. quad map shall be filed with the Department within six months after completion of the well;

(16) The bond covering the well shall remain in full force and effect until the well is properly abandoned and the surface is restored as near as possible to its original condition; and

(17) This permit shall expire 365 days from the date of issuance.

GILBERT COLOMA-AGARAN, Chairperson
Department of Land and Natural Resources

APR 10 2002
Date of Issuance

c: Land Board Members
Hawaii County Planning Department
Department of Business, Economic Development and Tourism
Department of Health
Office of Environmental Quality Control

APPLICATION FOR PERMIT TO DRILL
PROPOSED GEOTHERMAL WELL KAPOHO STATE 12
ON RESERVED LANDS, KAPOHO, PUNA HAWAII

Complying with Department of Land and Natural Resources (DLNR) Administrative Rule, Title 13, Chapter 183, Section 65, Puna Geothermal Venture (PGV) herewith makes application for a Permit-to-Drill for approval by the Hawaii Board of Land and Natural Resources.

1. **Applicant:**

Puna Geothermal Venture
P.O. Box 30
14-3860 Kapoho Pahoa Road
Pahoa, Hawaii 96778-0030
(808) 965-6233

PUNA GEOTHERMAL VENTURE

By: Michael Kaleikini for
Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture

Owner of Mining Rights:

Kapoho Land Partnership

Land Owner:

Kapoho Land and Development Company, Limited

2. **Proposed Well Designation:**

Kapoho State 12 (KS-12) off Wellpad B.

3. A tax key map, designating the approximate location of the drill site for KS-12 off Wellpad B located on State Geothermal Mining Lease R-2; a topographic map, designating the approximate surface elevation at Wellpad B of 610 feet above mean sea level; and a PGV Project map, designating the relative locations of KS-12 and Wellpad B are contained in Attachment I.

4. The proposed PGV Project geothermal well KS-12 has been designed to intersect near-vertical fractures, approximately 4000 feet to approximately 9000 feet true vertical depth (TVD). At least one drilling target will be for the purpose of providing geothermal resources to power the PGV project power plant, previously approved in the Plan-of-Operation approved March 10, 1989, by the Board of Land and Natural Resources. At least one other drilling target will be for the purpose of either providing a geothermal resource for, or injecting geothermal fluids and non-condensible gases from, the operation of the power plant.

5. A detailed Summary-of-Drilling Procedures is enclosed in Attachment II.

6. A detailed Well Drilling and Completion Plan, a Drill Site Plan, and a Vertical Section of the KS-12 well are contained in Attachment III.

7. A Summary-of-Drilling Reporting Criteria is enclosed in Attachment IV.

8. A description of Lithologic ("Mud") Logging Procedures is enclosed in Attachment V.

9. A multi-well drilling bond ($250,000) has previously been filed with the State of Hawaii.

10. Puna Geothermal Venture agrees to perform such drilling as outlined in this application and agrees to maintain the well in accordance with Title 13, Chapter 183, State of Hawaii, and all Federal and County geothermal regulations.

ATTACHMENT I

PUNA GEOTHERMAL VENTURE
TO DRILL KAPOHO STATE 12
A GEOTHERMAL WELL

I. General Information

a.	Well Designation:	Kapoho State 12
b.	Location:	TMK 1-04-01:19 Kapoho, Puna, Hawaii (Figure 1)
c.	State Geothermal Mining Lease:	R-2
d.	Owner of Mineral Rights:	Kapoho Land Partnership
e.	Subleased to:	Puna Geothermal Venture
f.	Operator:	COSI Puna, Inc.

II. Well Data

a.	Well Site:	Well Pad B (Figure 2)
b.	Well map coordinates:	154 53' 38" W 19 28' 48" N
c.	Well Type:	Development Well
d.	Surface Elevation:	610 feet AMSL (Figure 3)
e.	Projected Depth:	Approximately +/- 9000 feet True Vertical Depth (TVD)
f.	Target:	Fractured basalt below 4000 feet Measured Depth (MD)

The well bottom hole location will be directionally drilled to a target area which lies in an area which is vertically bounded by surface dimensions of approximately 1500 feet to the north, approximately 3700 feet to the east, a 100-foot minimum stand-off from the property boundary to the south, and approximately 800 feet to the west of the KS-12 wellhead location, at a depth of between approximately 4000 feet and approximately 9000 feet TVD, (Figure 2). At least two possible targets may be encountered. A shallow target is an intended production reservoir in a steeply dipping fracture zone to be intersected at a depth of between approximately 4000 feet and approximately 6000 feet TVD. A deep target would be at a depth of between approximately 6000 feet and approximately 9000 feet TVD, as another target for production or possibly injection.

III. Geology

Depth (MD):	Formation:
0 - 627 ft.	Unsaturated subaerial basalt flows and intercalated cinder scoria.
627 ft.	Water Table
627 - 3000 ft.	Saturated subaerial basalt flows and intercalated cinder scoria; rare dikes.
3000 - 4000 ft.	Interbedded hyaloclastite deposits and minor subaerial grading into submarine basalt flows; localized dike swarms.

4000 - 6500 ft.	Submarine basalt flows cross-cut by basalt dikes and possibly high-permeability, near-vertical fractures.
6500 - TD	Basaltic dike complex with locally recognizable submarine basalt flows.

ATTACHMENT II

PUNA GEOTHERMAL VENTURE
KS-12 DRILLING PROCEDURES
(Except as noted, all depths are referenced to KB.)

Location:
Elevation:
AFE#

1. Move in suitable rig and associated equipment. Rig up all accoutrements, including Top Drive, prior to spud.

    1.1. Notify DLNR 24 hours prior to rig up.
    1.2. Install soundproofing.
    1.3. Install direct communications between rig floor, tool pusher and company man.
    1.4. Comply with all sections of the Plan of Operations that pertain to drilling.
    1.5. Instruct drillers to remain on the floor at all times during drilling operations.
    1.6. Adhere to the Drilling Reporting Criteria.
    1.7. Provide DLNR with copies of the tour sheets daily.
    1.8. Conduct pre-spud meeting covering well control, H_2S, emergency medical evacuation, safety procedures and well program.
    1.9. Be sure location is secured with proper berms and ditches prior to spud.
    1.10. Weld on 30" conductor pipe and rig up flow line to bubble buster.
    1.11. Conduct Safety Inspections.
    1.12. Fill all mud tanks and storage tanks with water. Minimum total water delivery should be 30+ bbl/minute for possible well control. (See mud program)
    1.13. Rig up H_2S monitors and all safety equipment.

2. Drill 26" hole to +/- 700 feet.

    2.1. Make up a 26" stabilized bit on a mud motor with 10" Bottom Hole Assembly (BHA).
    2.2. Strap all tools below the motor.
    2.3. Use water as circulating medium and sweeping hole with calcium carbonate and pre-hydrated gel pills.
    2.4. Catch approximately 10-foot grab samples from drill cuttings and monitor for hydrothermal alteration whenever circulation permits.
    2.5. See attached mud logging (lithologic) procedures.
    2.6. Check returns, if any, for salinity and chlorides.
    2.7. Run maximum reading thermometer (MRT), with surveys, below 500 feet.
    2.8. Log temperatures in and out on tour sheets hourly.
    2.9. Continue drilling with water when lost circulation is encountered.
    2.10. Run drilling jars in all assemblies.
    2.11. At +/- 700 feet rig up and bail well until clean water samples are retrieved.
        2.11.1. Notify DLNR 24 hours prior to sampling.

2.11.2. Collect a representative water sample of ground water at +/- 650 feet.

2.12. Keep hole straight.

3. Continue drilling 26" hole to +/- 1000 feet. Casing shoe will be set in low permeability rock below major lost circulation zones. The casing will be set if high temperatures or hydrothermal alteration is encountered.

3.1. Notify PGV Drilling Manager if flow-line temperatures reach or exceed 150 degrees F, or if temperature rise exceeds 10 degrees F/100 feet.

3.2. Use conventional rotary drilling or mud motors, as appropriate, and water for circulating medium.

3.3. Use calcium carbonate, loss circulation material (LCM) or high viscosity sweeps to clean well bore as needed.

3.4. Set and polish off cement plug on bottom if formation is not competent.

3.5. Continue to monitor for flow or gasses.

3.6. Conduct BOPE and H_2S drills and log on tour sheet.

4. Circulate hole clean and make wiper run with stiff assembly.

4.1. Circulate hole clean after wiper trip.

4.2. Measure out of the well bore.

4.3. Keep hole full, if possible, and check for excess flow.

5. Rig up and run +/- 1000 feet of 22", 0.5" wall, K-55, BT&C or equivalent casing equipped with float shoe and screw-in float collar with latch down plug. Centralize casing approximately 10 feet above shoe, on the first collar and every third collar thereafter with "Semi-Rigid" centralizers.

5.1. Run casing at slow speeds to prevent down surge.

5.2. Fill casing as required to overcome buoyancy.

5.3. Have casing sized to remain 3-5 feet off of bottom.

5.4. Be sure casing is centered prior to cementing.

6. Run in hole with drill pipe and screw into 22" float collar.

6.1. Circulate hole clean. Reciprocate casing 5-10 feet while circulating to prevent differential sticking if well bore remains full.

7. Cement casing as per cementing program.

NOTE: If pressure drops off during cement job, pump tail slurry, drop and displace latch down plug and rig up for top job.

7.1. Monitor returns and surface pressures throughout job.

7.2. Center casing and wait on cement (WOC).

7.3. Be prepared to do a top job with High Early (accelerated) Redi Mix. Order out at least 30 yards Redi Mix. Add 50% silica flour to the last load.
7.4. Have at least 20 cubic yards of sand, gravel and/or volcanic cinders on hand to fill annulus through lost circulation zones if required.
7.5. WOC a minimum of 12 hours on initial cement job before drilling.

8. Cut off casing and weld on 22" 2000# casing flange.

8.1. Install pre-fabricated 22" 2000# slip on flange.
8.2. Install prefabricated 22" riser with 22" 2000# flanges and 2 each 6" side outlets with 6" valves and 6" rupture disks or air actuated rubber bladder for diverter lines.

9. Install 22" 2000# annular preventor and rotating head.

9.1. Notify DLNR 24 hours prior to testing.
9.2. Test BOPE and casing and have DLNR witness and approve test.
9.3. Log test results on tour sheet and morning report. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
9.4. Periodic BOPE drills will be conducted and logged on tour sheets.
9.5. Install and test high efficiency mud cooler. Run coolers, if and as needed.
9.6. All personnel will have BOPE training. Training will be logged on the daily tour report.

10. Make up 20" bit on slick assembly. Clean out cement with mud.

10.1. See mud program.

11. Drill 1-5 feet of new 20" hole and circulate clean with mud.

12. Perform leak-off test with 6" valves closed and squeeze if necessary.

13. Install 6" diverter lines. Install H_2S abatement equipment on deviator lines.

14. Make up BHA and drill 20" hole to +/- 2200 feet.

14.1. Keep hole straight.
14.2. Survey at approximately 90-foot intervals and run MRT.
14.3. Catch 10-foot grab samples, clean, dry, bag in envelopes and label two complete sets of samples.
14.4. Check mud for increased salinity and chlorides.
14.5. Monitor well for increase or decrease in flow rates and gasses.
14.6. Keep close watch on samples for changes in mineralogy indicative of a high temperature geothermal reservoir.
14.7. Be prepared to set casing if there are any signs of encountering a high temperature reservoir.

14.8. Cement off all lost circulation zones.

15. Run high pump volumes to properly clean hole.

15.1. Run all solids control equipment. Use course shale shaker screen if necessary to handle volume. This will be a closed loop system.
15.2. Keep a close eye on the sumpless system, do not let the cuttings tank overflow. Run mud cleaner at all times.
15.3. Keep plastic viscosity and gel strengths as low as possible with at least a 1/32" mud cake and a water loss of 10.

16. Circulate hole clean and make wiper trip to shoe.

16.1. Measure out of the well bore. Keep hole full at all times.
16.2. Monitor well and be sure well takes proper amount of fluid.
16.3. Check and log any fill on bottom.
16.4. Circulate hole clean and pump sweep.

17. Pull out of the well bore keeping hole full.

18. Rig up and run 16", 97#, L-80, BOSS thread casing equipped with float shoe, float collar one joint above shoe and extended casing packer (ECP)/Port collar just below 22" casing shoe. Centralize approximately 10 feet above shoe, on first, second third and every third collar thereafter with "Double Bowed" centralizers. Do not use centralizers inside of 22" casing.

18.1. Use thread protectors.
18.2. Run casing at slow speeds to prevent down surge.
18.3. Fill casing with mud while running.
18.4. Continue monitoring the well. Keep hole full.
18.5. Have casing sized to remain off of bottom and to keep collar out of cut off area.

19. Circulate and condition hole for cement. Cement casing using two stages. Do not circulate anything but cement after opening port collar. Do not displace excess cement in annulus with anything but more cement, keep all water and fluids out of annulus.

20. Cement casing as per cementing program.

20.1. Monitor returns and pressures throughout job.
20.2. Inflate ECP with cement after bumping plug as per cementing program.

21. WOC at least 12 hours.

22. Cut off casing and install 16" 5000 casing head, using "Hot-Hed" system for stress release. Test weld to approximately 2500 psi with nitrogen.

23. Install 16" 5000# mud cross, 16" 5000# double gate, 16" 5000# Banjo Box or Flow Tee or equivalent with rupture disk and remote-operated valve to blooie line. Install 16" 5000# double gate, 16" 5000# annular preventor, rotating head , choke and kill lines, blooie line and muffler. Also, connect water and abatement lines to the blooie line, as shown in the BOPE attachments. Install and check all monitoring equipment. WOC 16 hours prior to testing.

24. Be sure all monitoring equipment is in place including well head pressure gauge.

25. Notify DLNR 24 hours prior to BOPE test.

    25.1. Log all test results and approvals on tour sheet and morning report.
    25.2. All pushers, drillers and derrick men will be trained in the use of monitoring equipment. Training will be logged on the tour sheets.
    25.3. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
    25.4. Install test plug and test BOPE to approximately 2500 psi below top double gate.

26. Make up 14¾" bit on a slick BHA to clean out cement and floats.

    26.1. Drill 3-5 feet of new hole and circulate clean with mud.
    26.2. Perform leak-off test with mud and squeeze if necessary.

27. Drill 14¾" hole to +/- 5000 feet. Casing point will be in the cap rock above the reservoir as determined by the well site geologist using the criteria described in the "Plan of Operations".

    27.1. Run profile nipples in all drilling assemblies.
    27.2. Raise the mud weight while drilling to 10.8#/gallon. Below approximately 3200 feet, maintain approximately 2100 psi hydrostatic pressure at the bit or sufficient hydrostatic to prevent flow if required.
    27.3. Perform directional drilling in the 14¾" hole section. Survey as required with intervals not to exceed approximately 120 feet'. Run MRT with all surveys. See directional program.
    27.4. Catch 10-foot grab samples of drill cuttings.
    27.5. Keep close watch on all mud properties. Keep pH concentration at about 9. See mud program.
    27.6. Monitor well for increase or decrease in flow rates and gasses.
    27.7. Keep close watch on samples for changes in mineralogy indicative of a high temperature geothermal reservoir.
    27.8. Be prepared to set casing if there are any signs of encountering a high temperature reservoir.
    27.9. Observe drill pipe pressure prior to connections. If there is pressure on drill pipe with pump off and no flow at flow line, even with a float in the string, then a steam bubble may be forming in the drill string.
    27.10. Cement off all lost circulation zones. If necessary, reduce mud weight.

27.11. Turn on one mud cooler when flow line temperature reaches 150 degrees F. Turn on second mud cooler when flow line temperature again reaches 150 degrees F.
27.12. If well indicates flow or pressure during trips, cool hole with both coolers on and then recheck well for flow.

28. Circulate hole clean and wipe hole to shoe. Strap out.

29. Rig up and run 11¾", 65#, C-90, SLHC thread casing equipped with Float Shoe, Float Collar 80 feet above shoe, ECP and port collar just inside of 16" casing.

29.1. Use thread protectors. Run casing at slow speed to prevent down surge but fast enough to arrive at bottom prior to major heat build up. Fill casing with mud while running to overcome buoyancy.
29.2. Keep monitoring well. Keep hole full at all times and have casing sized prior to running.
29.3. Centralize casing as follows: approximately 10 feet above shoe, 1st, 2nd, 3rd, and every 4th collar to the 16" shoe. Use positive centralizers inside of the 16" casing, on 1st collar above the ECP and every 3rd collar to the first collar below ground level.
29.4. Size casing so no collar will be in the expansion spool pack off area.
29.5. Centralize casing with casing rams in the lower BOPE and casing head brass set screws.

30. Circulate and condition hole for cement job, monitor flow line temperature and be sure the temperature has dropped off prior to cement job. Conduct cement procedure review with all participants prior to cementing. Cement casing using two stages with NO water between stages. See attached Cement Program and cement accordingly.

31. WOC a minimum of 16 hours.

32. Cut off casing and install expansion spool as directed by Expansion Spool representative.

32.1. Use hydraulic torque wrench on all studs attached to the expansion spool (including those on wing valves).
32.2. Use Power Plant (Power Piping Code) pattern and tighten all studs to maximum specifications.
32.3. Seal weld centering ring hold-down studs to eliminate any chance of leakage, after tightening.
32.4 Test to approximately 3500 psi with nitrogen.

33. Install 12" 1500 Series Master Valve and BOPE (See attached BOPE figure).

33.1. Use power plant (Power Plant Piping Code) pattern and tighten all studs to maximum specifications when installing Master Valve.
33.2. Notify DLNR 24 hours prior to testing BOPE.
33.3. Test casing to approximately 2000 psi or 70% of burst, whichever is less.

33.4. Install test plug and test BOPE to approximately 3500 psi below top double gate.
33.5. Test BOPE above top double gate to approximately 2500 psi and annular preventor to approximately 2000 psi.
33.6. Test to be witnessed and approved by DLNR. Log all test results and approvals on tour sheet and morning report.

34. Clean out casing and drill 1-5 feet of new hole below shoe.

34.1. Circulate hole clean and cool.
34.2. Perform leak-off test and squeeze if required. Pressure gradient will be provided by Drilling Manager.

35. Drill 10⅝" hole to +/- 8000 feet TVD or until sufficient production is encountered.

NOTE: 8⅝", 36#, L-80, SLHC thread casing may be run and cemented with Double lip Liner Hanger if 11¾" casing is deemed too shallow or formation is unstable. (See supplemental program – following pages.)

36. Continue drilling 10⅝" hole or (7⅞" hole if 8⅝" casing has been set) to TD.

36.1. Use mud weight that provides approximately 2150 psi hydrostatic head pressure at the casing shoe and maintain mud weight sufficient to provide approximately 2150 hydrostatic while drilling.
36.2. Take surveys every 120 feet and include MRT.
36.3. Catch 10-foot grab samples of drill cuttings.
36.4. Keep close watch on mud properties. Weight up as needed to control well. Keep pH at approximately 9.
36.5. Be sure all monitoring equipment is in good working order.
36.6. Watch closely for flow or loss and for changes in mineralogy indicative of high temperature geothermal reservoir.
36.7. Run both mud coolers.
36.8. If well indicates flow or shut in pressure during trips, cool hole with circulation and recheck hole parameters.
36.9. Stroke Master Valve from full open to close and function test BOPE on every trip.

37. T.D. will be Kelly down after total loss circulation occurs or one connection below which is approximately 90 feet with Top Drive connections.

37.1. Place well on kill line at 5-7 barrels per minute and strip out of the well bore to shoe.
37.2. Monitor well while stripping out and maintain vacuum.
37.3. Notify Drilling Supervisor and Drilling Manager immediately.

38. Upon reaching shoe, be sure well is shut in.

38.1. Displace drill string with soapy water.

38.2. Build mud volume to full capacity with proper kill weight mud.
38.3. Kill well with mud and place well on kill line at 5-7 barrels per minute.
38.4. Strip out of the hole and monitor well head pressure closely. Maintain well on vacuum of at least –1 (negative one) psi well head pressure.
38.5. Close blind rams and start pumping water at 8-10 barrels per minute for at least 5 hole volumes. Monitor well head pressure (WHP).
38.6. Close Master Valve. Monitor WHP.

39. Lay down drill pipe and tools in mouse hole. Tighten all flanges on well head equipment and valves.

40. Tear out BOPE and install second 12" 5000# Master Valve. Install companion flange and swab valve.

41. Install Barton recorder and dial gauge to monitor well pressure.

42. Secure well, rig down and move rig out.

43. Release well to O&M. Note release time on tour sheets.

44. Submit well completion records including: Well record sheet, bit record casing details, pipe measurement records, well schematic diagram, well head assembly diagram and serial numbers of well head valves to Puna Geothermal Office within one week.

Supplemental Program for 8⅝" Casing

NOTE: If 11¾" casing was set earlier than approximately 5000 feet due to hydrothermal alteration or formation was deemed to be unstable, then proceed with the following supplement.

1. Drill 10⅝" hole from shoe of 11¾" casing to +/- 5000 feet following guidelines found in Step 36.

2. Circulate the well clean. Pull out of the well bore to the shoe of the 11-¾" casing and run back to bottom.

2.1. Circulate the hole clean and cool.
2.2. Measure drill string while pulling out of the well bore.

3. Rig up and run 8⅝", 36#, L-80 SLHC thread casing, equipped with Float shoe and Float collar placed approximately 80 feet above shoe, and Double Slip liner hanger made up on top joint prior to running casing. Casing will be stabilized with Semi Rigid centralizers placed 10 feet above shoe, 1st, 2nd, 3rd and every other collar thereafter.

3.1. Maintain an approximately 200-foot lap inside of the 11-¾" casing.
3.2. Use thread protectors and run casing at slow speeds.

4. Tag bottom for redundancy of pipe tally. Circulate to clean and cool well bore.

    4.1. Be sure temperature has dropped at flow line prior to cementing.
    4.2. Reciprocate liner while circulating.

5. Hang 8⅝" liner 10 feet from bottom and break nut on liner hanger.

    5.1. Cement casing as per attached Cement Program.
    5.2. Unscrew from liner hanger and pull out of hole (POOH).
    5.3. Do not circulate cement out of the hole above liner hanger.
    5.4. WOC

6. Make up 10⅝" bit on slick assembly and run in hole (RIH). Clean out cement to the top of the Liner Hanger

    6.1. Circulate hole clean and POOH.

7. Make up 7⅞" bit and clean out Chevron Packing and cement to top of the float collar.

    7.1. Circulate hole clean.
    7.2. Notify DLNR of casing integrity test 24 hours in advance.
    7.3. Pressure test liner lap to 0.9 gradient or as specified by Drilling Manager.
    7.4. Squeeze lap if necessary.

8. Test casing and BOPE and record on tour sheet along with DLNR approval.

9. Drill out cement, Float Collar and Shoe.

10. Drill 7⅞" hole to TD following the procedures laid out in Step 36 of the Drilling Program.

ATTACHMENT III
PUNA GEOTHERMAL VENTURE
DEVELOPMENT WELL DRILLING PLAN
FOR WELL KS-12

CONDUCTOR CASING AND CELLAR:

A 30" conductor pipe will be set in a 42" hole that was drilled to a depth of 70 feet below ground level. The conductor is to be cemented in place with concrete placed down the backside of the 30" conductor pipe.

If a cellar is not already in place, then, following the setting of the conductor pipe, dig an earthen cellar and construct a reinforced concrete cellar according to civil contractor's design and specifications (Figure 3-1).

DRILLING - 26" HOLE:

Rig up a suitable drilling rig as shown in Figure 3-2. Weld on 30" pitcher nipple. Spud in with 26" bit. Anticipate losing total returns at any time below surface. Continue drilling ahead on water, aerated mud or foam without returns. Run maximum reading thermometer (MRT) during directional surveys every 90 feet below a depth of approximately 500 feet. Drill to a depth of 700 feet.

At this depth rig up bailer and bail continuously or as required to get a representative ground water sample. Collect samples and send to lab for analysis. Have DLNR witness sampling procedure. Notify DLNR 24 hours prior to taking samples.

Resume drilling 26" hole on water, aerated mud, or foam. Drill to a depth of approximately 1000 feet, the casing point for 22" casing. If abnormal temperatures are encountered, then notify the drilling superintendent and stop drilling. The 22" casing may be set at that point after consulting with and receiving permission from Department of Land and Natural Resources (DLNR).

SURFACE CASING:

Approximately 1000 feet of 22", 0.5" wall, K-55, BT&C or equivalent casing will be run and cemented in place (Figure 3-3). Run casing while filling on every second joint.

Cement 22" casing through drill pipe with Hawaii cement + 40% silica flour.

Wait on cement for 12 hours. Have at least 200 cubic yards of sand, gravel, and/or volcanic cinders on hand.

Pick up and run 1" tubing down backside of 22" casing. Tag fill. Mix and pump Hawaii cement + 40% silica flour. Circulate to surface. Pull tubing and wash while laying it down. Wait on cement for 12 hours. Should the cement settle, top out with batched ready-mix poured down the backside of the 22" casing. Ready-mix can be accelerated with 2% by weight of calcium chloride. Wait on cement for 12 hours.

BLOWOUT PREVENTION EQUIPMENT (20" BOPE) 22" HOLE (Figure 3-4):

Cut off casing and weld on 20" 2000# casing flange and 2 side outlets. Valve the outlets with 3" gate valves.

Blowout prevention equipment to drill a 20" hole shall consist of a 20" 2000# annular preventer and diverter system as shown in Figure 3-4. Test BOPE, per DLNR requirements, and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing.

DRILLING 20" HOLE:

Drill out from underneath the 22" surface casing with mud. Make up a 20" mill tooth bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent of approximately 10#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Drill out and trip for bottom hole assembly.

Should lost circulation persist, loss interval(s) should be cemented.

The 20" hole is to be drilled to a depth of approximately 2000 feet where 16" casing is to be run.

INTERMEDIATE CASING:

Approximately 2000 feet of 16", 97#, L-80, BOSS thread casing is to be run and cemented in place in a single stage (Figure 3-3).

Cement with Hawaii cement + 40% silica flour. If losses are encountered below the 22" casing shoe, then it may be advisable to cement the 16" string with a light weight cement slurry tailed by 200 sacks of tail slurry. Pump 60% excess.

BLOWOUT PREVENTION EQUIPMENT (16" BOPE) 14¾" HOLE (Figure 3-5):

Cut off casing and install 16", 5000# casing head. Blowout prevention equipment to drill a 14¾" hole will consist of a mud cross, two 16" 5000# double gate preventers, a 16" 5000# annular preventer, a banjo box/flow tee/equivalent with rupture disk and single gate preventer on the side outlet with blind ram inserts, a rotating drilling head, choke, and kill line (Figure 3-5). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment on blooie line (Figure 3-8).

DRILLING 14¾" HOLE:

Drill out the shoe with a 14¾" bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent to 11#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Squeeze if required. Trip for bottom hole assembly. Drill to casing point at approximately 5000 feet.

PRODUCTION CASING:

Approximately 5000 feet of 11¾" 65#, C-90, SLHC thread casing is to be run and cemented (Figure 3-3). Cement casing with Hawaii cement + 40% silica flour. After WOC, cut off the 11¾" casing. Nipple up 16" 5000# x 12" 1500 Series expansion spool with packing sleeve.

BLOWOUT PREVENTION EQUIPMENT (13⅝" BOPE) 10⅝" HOLE (Figure 3-6):

Blowout prevention equipment to drill the 10⅝" section of hole should consist of a 12" 5000# gate valve, 12" 5000# x 13⅝" 5000# double-stud adapter (DSA), two 13⅝" 5000# double gate preventers, a 13⅝" 5000# annular preventer, a banjo box/flow tee/equivalent with a rupture disk and a single-gate preventer on the side outlet, a rotating drilling head, choke, and kill line (Figure 3-6). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment and muffler on blooie line and choke line. Provisions will be made to abate any well flow from the choke line or the blooie line.

DRILLING 10⅝" HOLE:

Drill out from underneath the 11¾" casing on water with a 10⅝" bit and slick bottom hole assembly. Perform leak-off test and note test results on IADC tower report. Squeeze if required. Notify appropriate State agencies 24 hours prior to testing. Trip for packed BHA and continue drilling ahead on mud.

Should differential sticking occur, rig up the air compressor and circulate with air to free the stuck string.

At total depth (TD) circulate out mud with fresh water. Trip-out of hole and rig up flow test. If test is successful, then run perforated liner, if required to keep the hole open.

PRODUCTION LINER (Primary and Alternate Drilling Target):

Production liner will be run only if it is needed to keep hole open. Trip in hole with slick BHA and check for fill. If hole is open, then run approximately 3000 feet of 8⅝", 36#, L-80, Buttress Thread and Coupling (BTC) casing perforated with round holes. Run liner with cement guide shoe on bottom and hang on a single slip cone type liner hanger (Figure 3-3). Release from hanger and trip out laying down.

Nipple down BOPE and install final wellhead for production well, as shown in Figure 3-7.

ATTACHMENT IV
PUNA GEOTHERMAL VENTURE
DRILLING REPORTING CRITERIA

1. The Drilling Supervisor shall report to the PGV Drilling Engineer or his designated relief on the day-to-day operations.

2. As closely as possible, the Drilling Supervisor will follow the drilling program for a particular well as provided by the Drilling Engineer. There will be changes in the drilling program as the well progresses, and these changes must be discussed with the Drilling Engineer before action is taken.

3. Approximate casing setting depth will be set in the Drilling Program with assistance from the Geologist. These depths should be used absent other information A mud program will be outlined in the Drilling Program, and this program should be followed as closely as possible. The Drilling Supervisor shall have ample latitude to change the mud program as dictated by the actual drilling conditions.

4. Historical drilling data have been developed regarding the Puna Geothermal Project, and this data should be used to the best advantage in drilling wells within the project.

5. In and out mud temperatures and maximum recording temperatures will be logged on the IADC tower report.

6. When drilling below the 16" casing shoe, special precautions must be taken when encountering any lost circulation zones or drilling breaks.

7. If a drilling break is encountered while drilling, then the pipe should be picked up to properly place tool joint and bottoms up should be circulated around. The PGV Drilling Supervisor should be immediately notified along with the contractor's supervisor. A temperature survey should be run whenever a drilling break is encountered. An interpretation of the survey should be made by the Drilling Engineer before drilling further. It is important not to drill ahead with excessive temperature in the mud returns.

8. The driller should also note in the IADC tower report any gains or losses in the mud pit volume. Any significant mud loss should be reported to the PGV supervisor(s) and the Contractor's supervisor(s). If any continuous or significant mud gain is encountered, then the driller should pick up the pipe and check for flow and notify the supervisors. If flow is observed, then the well will be shut in immediately.

9. Based on past experience at the Puna Geothermal Project, it is imperative that constant supervision of the well be accomplished once drilling is undertaken below the 16" casing shoe.

10. PGV Supervisors will be in charge of all activities on location. PGV Supervisors will report to the PGV Drilling Engineer or Drilling Manager.

11. Drilling Supervisors will spend sufficient time together at the rig during change-out to exchange information on the current activities. Drilling Supervisors will be on the floor, on the pump truck, in the wireline unit, etc. for all critical operations.

12. The Drilling Engineer will be responsible for engineering programs with input from the Drilling Supervisors. The Drilling Engineer will also advise and assist the Drilling Managers and Supervisors.

13. Contractor's supervisors will report to the Drilling Supervisor on location. They will also be on the floor during all crew changes.

14. Reporting procedures for crews will be the responsibility of the drilling contractor. Drillers will log all rig operations on the IADC daily tower report, including the depths of all work performed. Rig crew will assist service company personnel as directed by the contractor's supervisor.

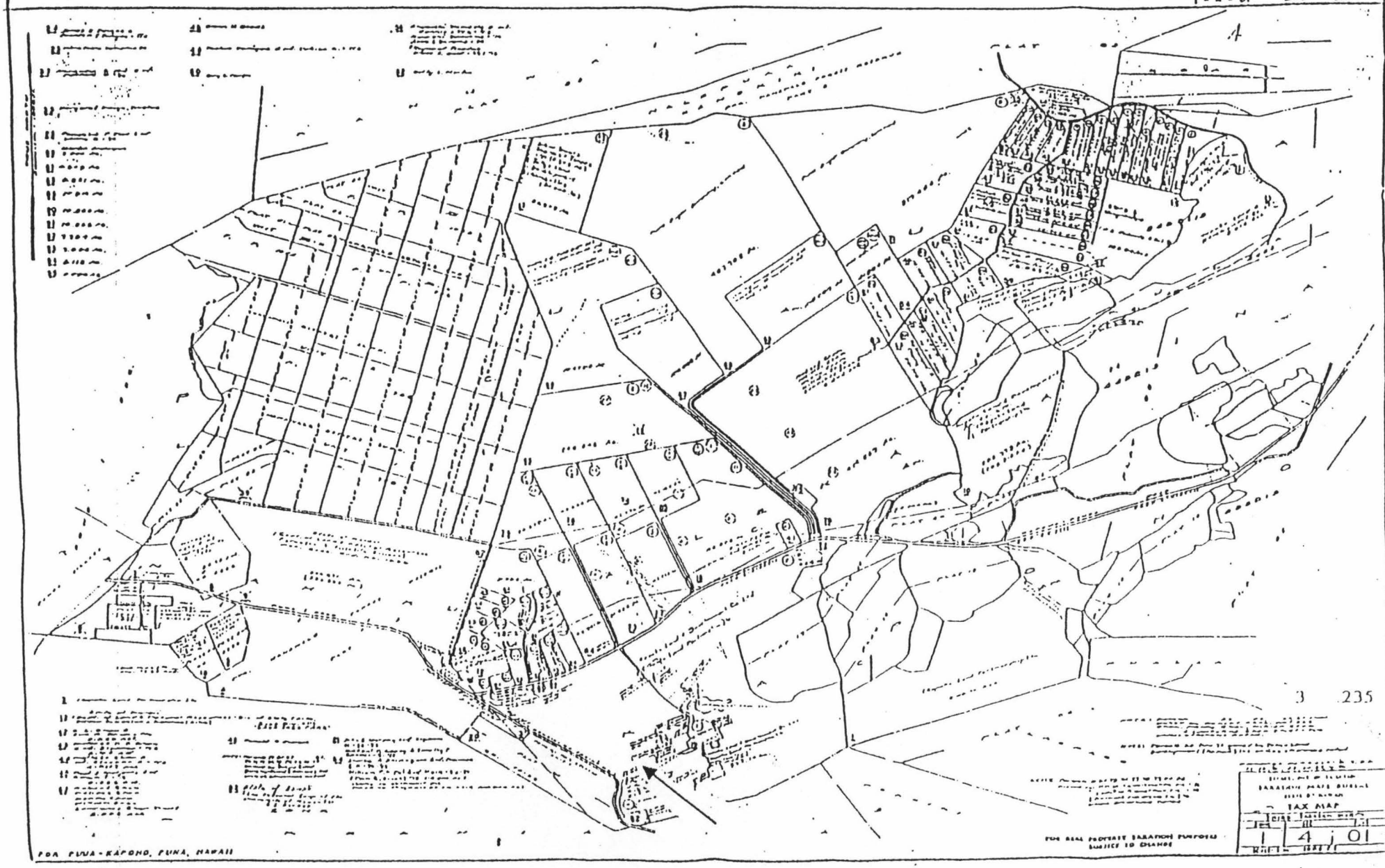
ATTACHMENT V
PUNA GEOTHERMAL VENTURE
PROCEDURES FOR LITHOLOGIC ("MUD") LOGGING

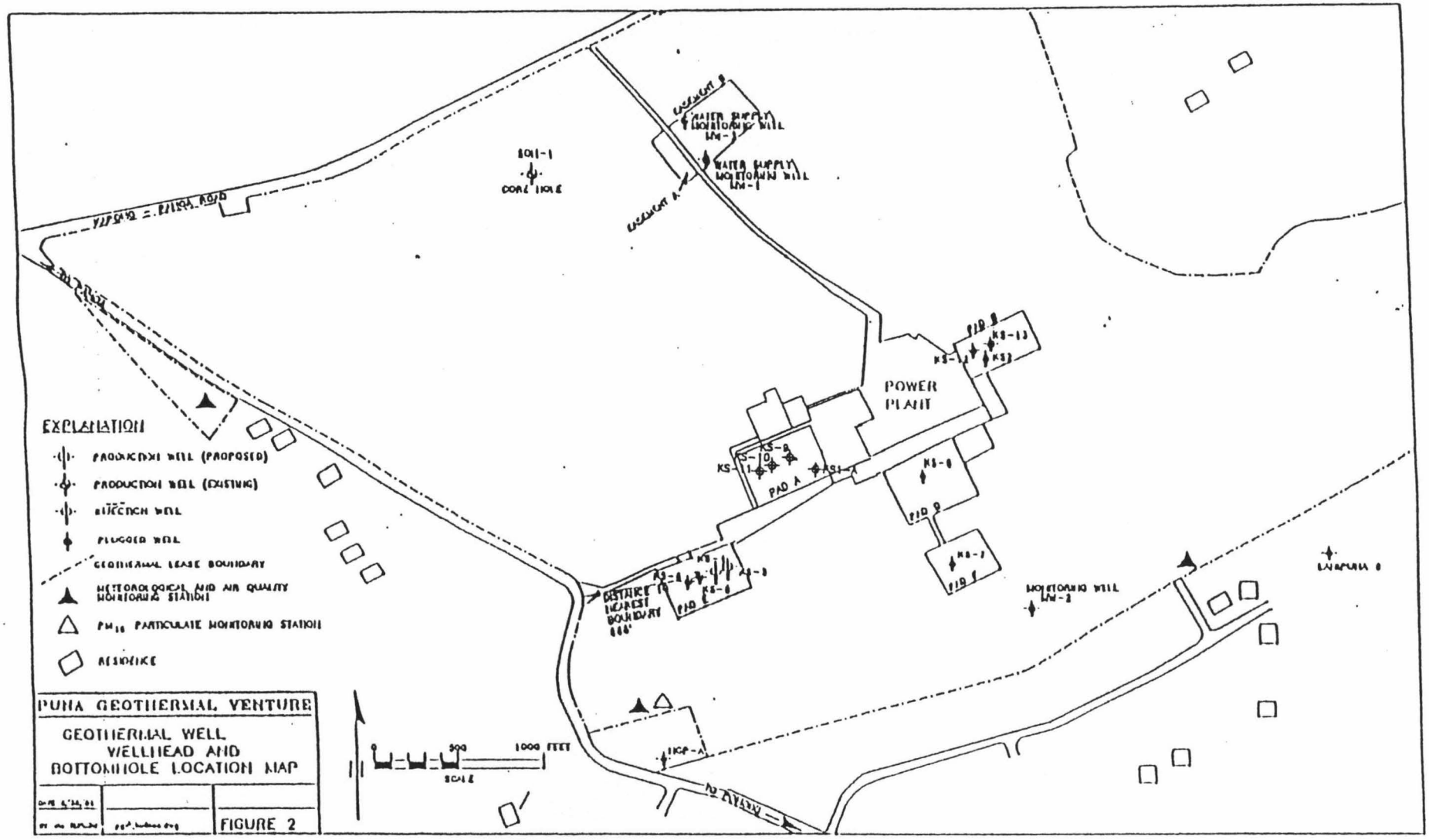
While drilling, depths are recorded on a Bristol chart (a circular chart matching time versus depth). As a single joint is drilled, each ten-foot interval (i.e., 100, 110, 120, etc.) is marked and labeled on the chart. A lag time (the interval of time, measured in minutes, required to circulate drilling fluids from the bit to the surface) is calculated based on hole size and pump rates and a marker is set to indicate when a marked depth reaches the surface.

When drilling fluids containing suspended drill cuttings derived from a given interval reach the surface, such fluids travel down the flow line and over the mesh shaker screens. After the latest ten-foot interval has accumulated at the base of the shakers, the mud logger obtains a representative sample of the drill cuttings. The sample is then washed of the drilling fluid. One portion of the cuttings, the wet sample, is placed in a plastic bag and the remainder is dried and bagged in sample sets.

A small amount is retained to view under a stereomicroscope. The cuttings from each ten-foot interval are then visually and physically evaluated. Detailed written descriptions of each ten-foot interval are entered on work sheets which are subsequently summarized onto the mud log data sheet. The lithologic descriptions include rock type, color, texture, hardness, structural characteristics, alteration (if any) and secondary mineralization.

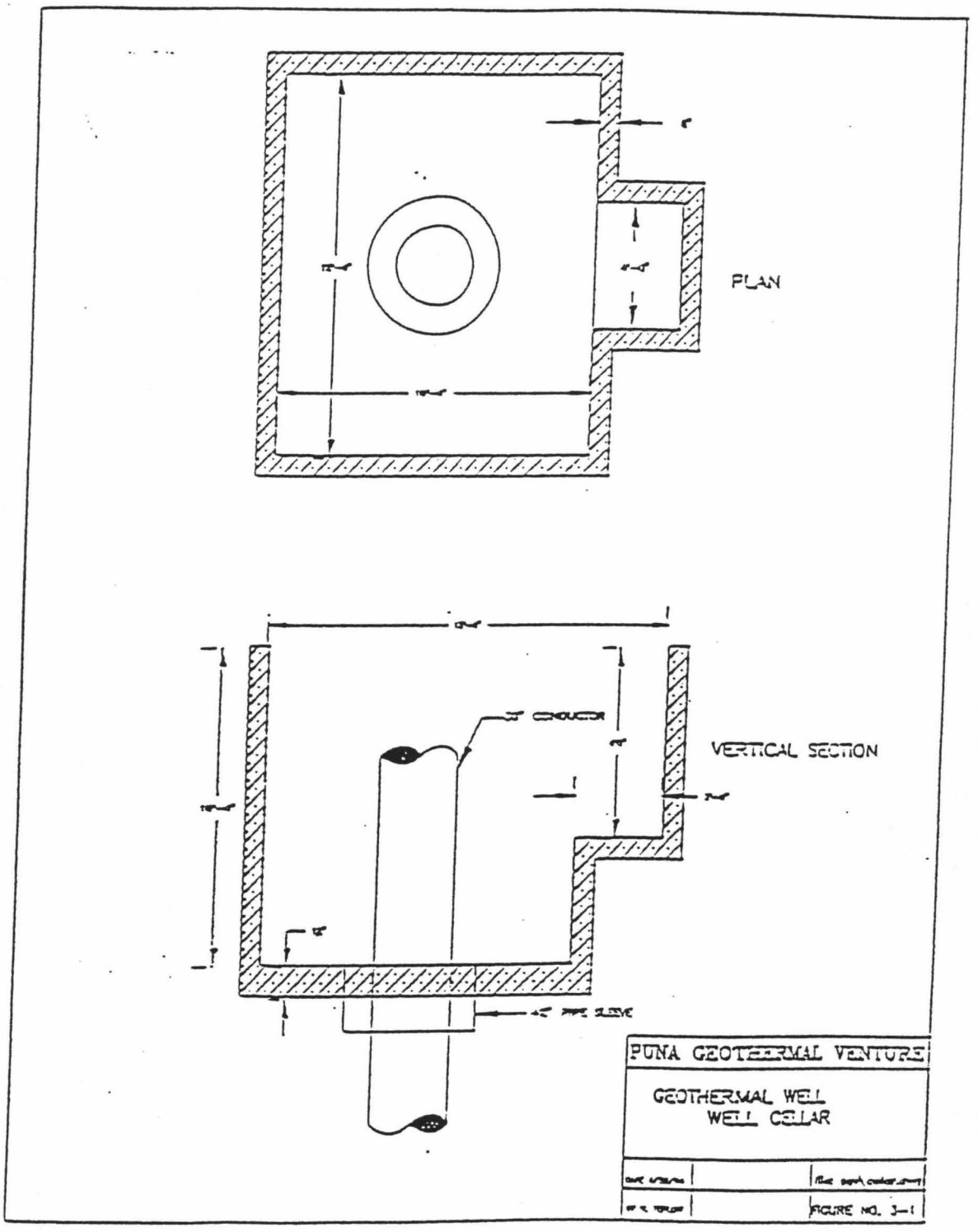
FIGURE 1

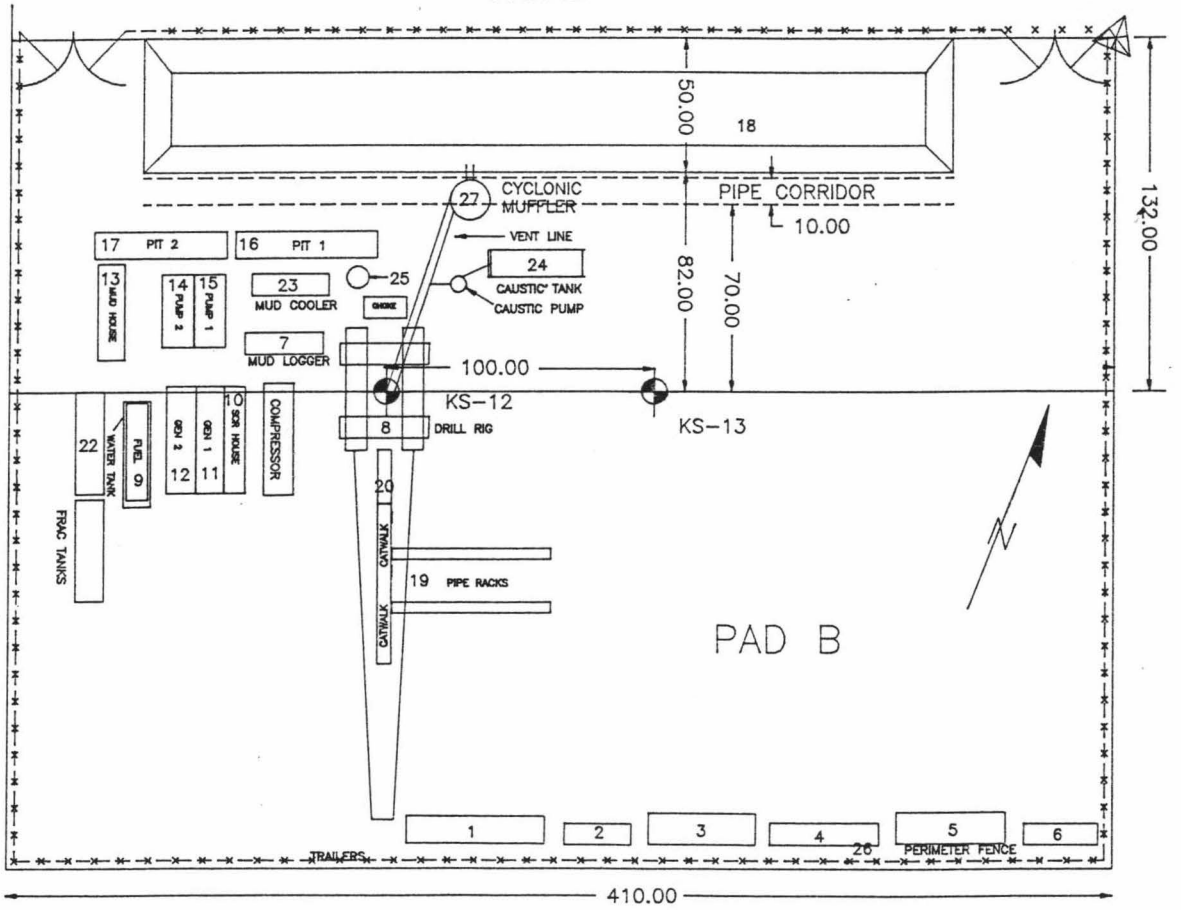

1 - 4 - 01
3RD DIV.
4
3
235
TAX MAP
1
4
01
FOR REAL PROPERTY TAXATION PURPOSES
SUBJECT TO CHANGE
FOR PUNA-KAPOHO, PUNA, HAWAII


POWER PLANT
PAD A
EXPLANATION
PRODUCTION WELL (PROPOSED)
PRODUCTION WELL (EXISTING)
REINJECTION WELL
PLUGGED WELL
GEOTHERMAL LEASE BOUNDARY
METEOROLOGICAL AND AIR QUALITY MONITORING STATION
PM_{10} PARTICULATE MONITORING STATION
RESIDENCE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL WELLHEAD AND BOTTOMHOLE LOCATION MAP
FIGURE 2
500
1000 FEET
SCALE

ISLAND OF HAWAII—PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)
Puulena Crater
Kaluwa Crater
Observatory
Kilauea
MAUNA LOA
KILAUEA

FIGURE 3


PLAN
VERTICAL SECTION
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL
WELL CELLAR
FIGURE NO. 3-1



8471.28 N
9453.90 E

EQUIPMENT LIST

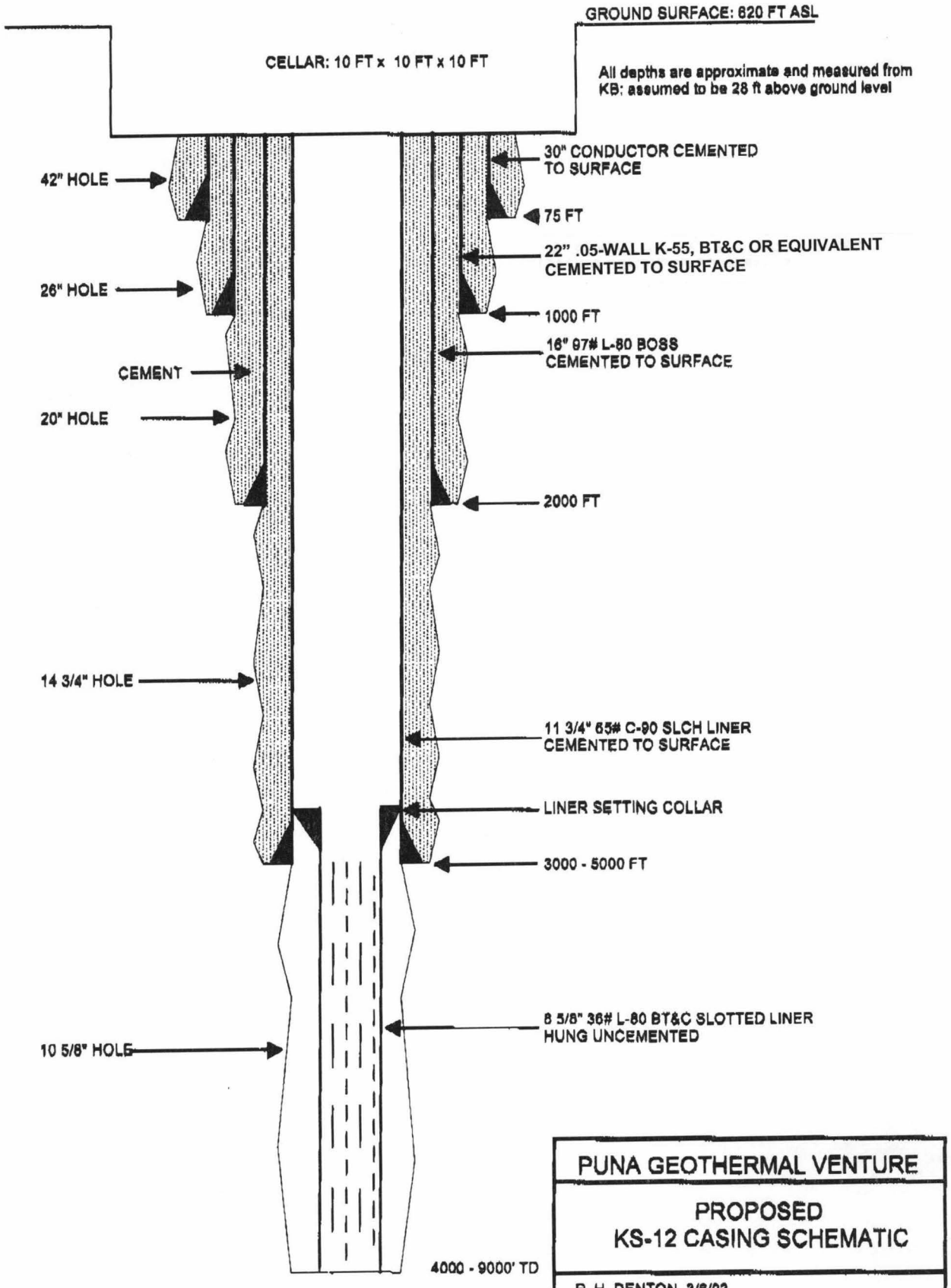
ITEM	HEIGHT (FT)
1. GEOLOGIST TRAILER	14.0
2. DIRECTIONAL SERVICES	12.0
3. AIR SERVICES	12.0
4. TOOL PUSHER	12.0
5. DRILLING SUPERINTENDENT	14.0
6. MUD SERVICES	12.0
7. MUD LOGGER	12.0
8. DRILL RIG	168.0
9. WATER TANK\FUEL TANK	20.0
10. SCR HOUSE	10.5
11. GENERATOR #1	10.7
12. GENERATOR #2	10.7
13. MUD HOUSE	9.4
14. MUD PUMP #1	10.5
15. MUD PUMP #2	10.5
16. MUD TANK #1	4.4
17. MUD TANK #2	4.4
18. RESERVE PIT	-10.0
19. PIPE RACKS (2)	6.7
20. CATWALK	4.4
21. AIR COMPRESSOR	20.0
22. FRAC TANKS (4)	14.0
23. MUD COOLER	24.1
24. CAUSTIC TANK	14.0
25. DEGASSER	20.0
26. PERIMETER FENCE	7.0
27. CYCLONIC MUFFLER	15.0

0 50 100 FEET
SCALE

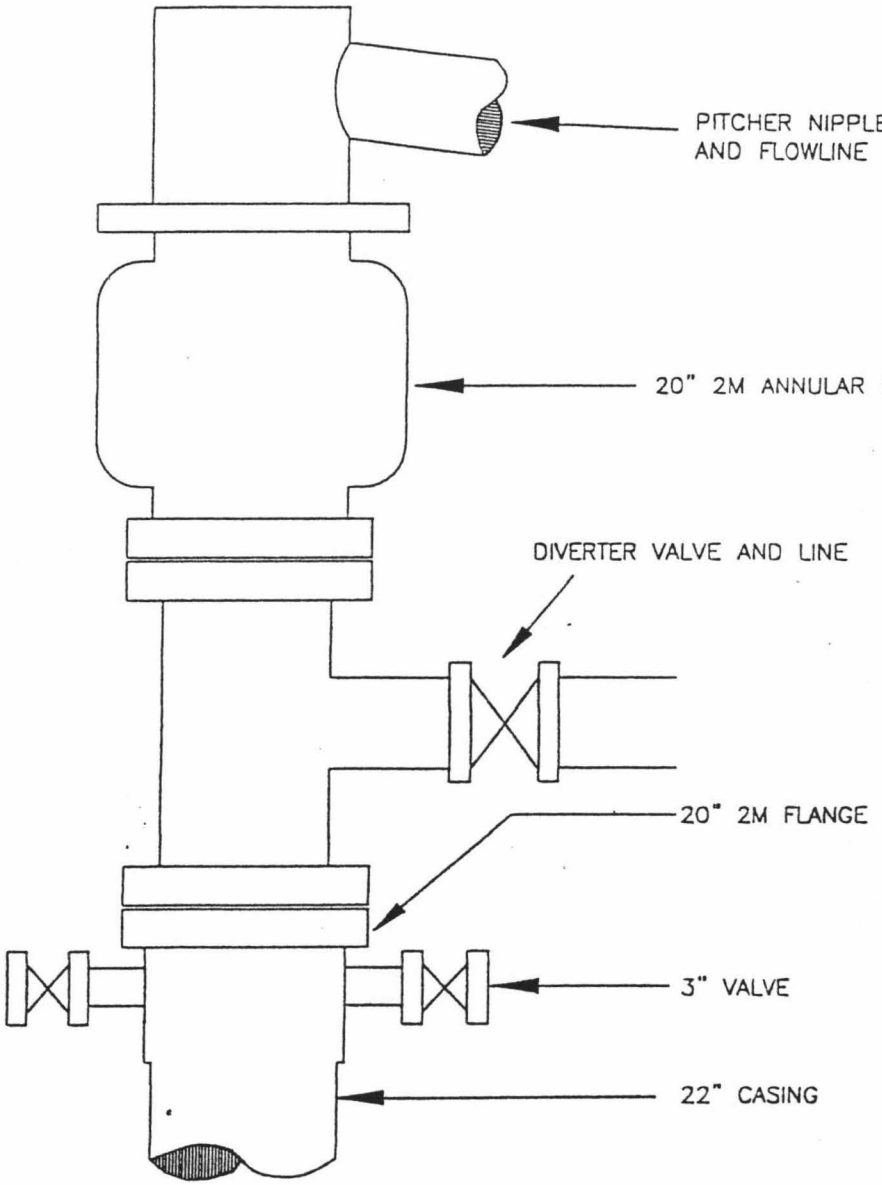
PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL KS-12
RIG LAYOUT

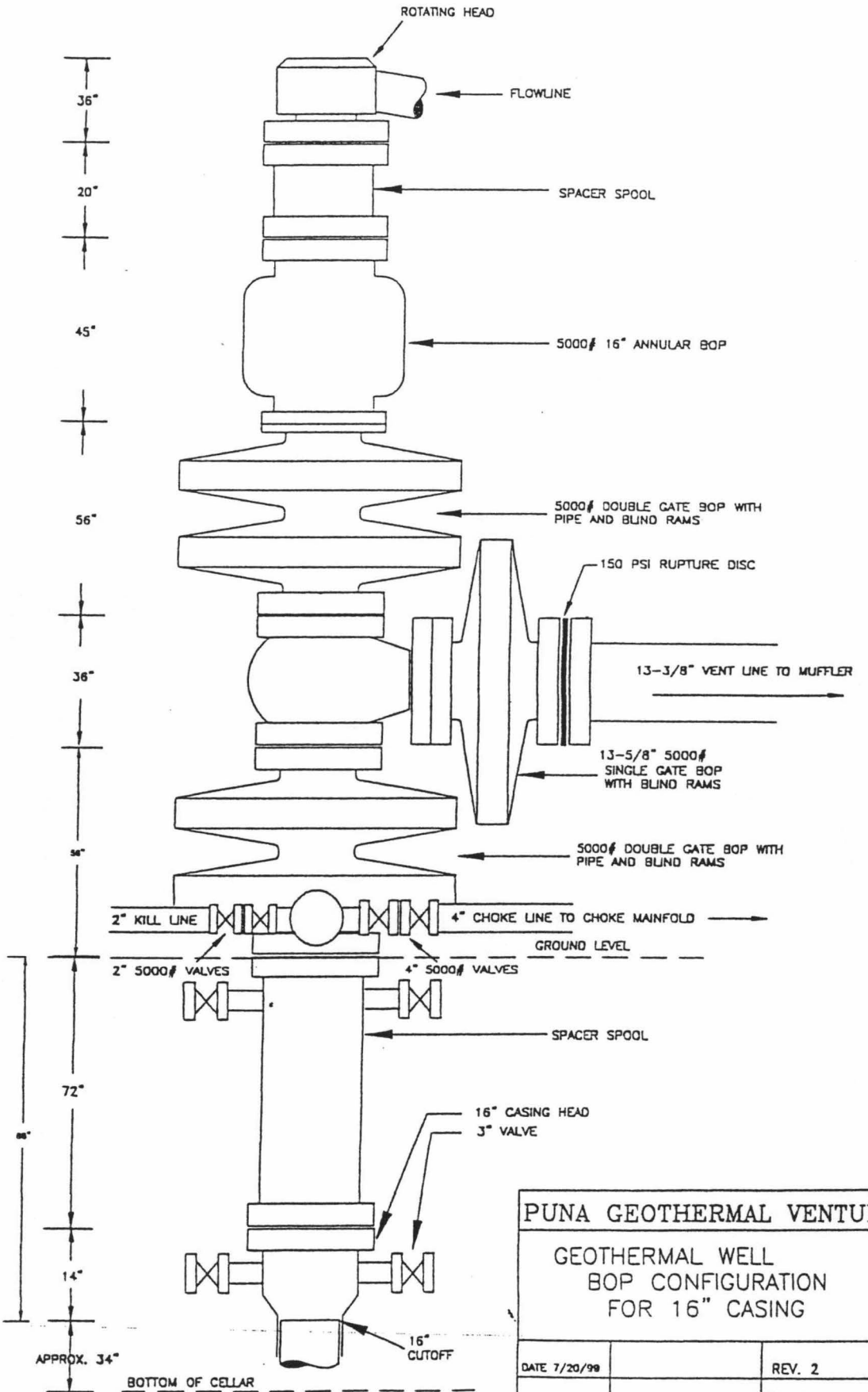
REV. 3/20/94		FILE: PGV\KS12PARK
BY W. TEPLOW		FIGURE NO. 3-2



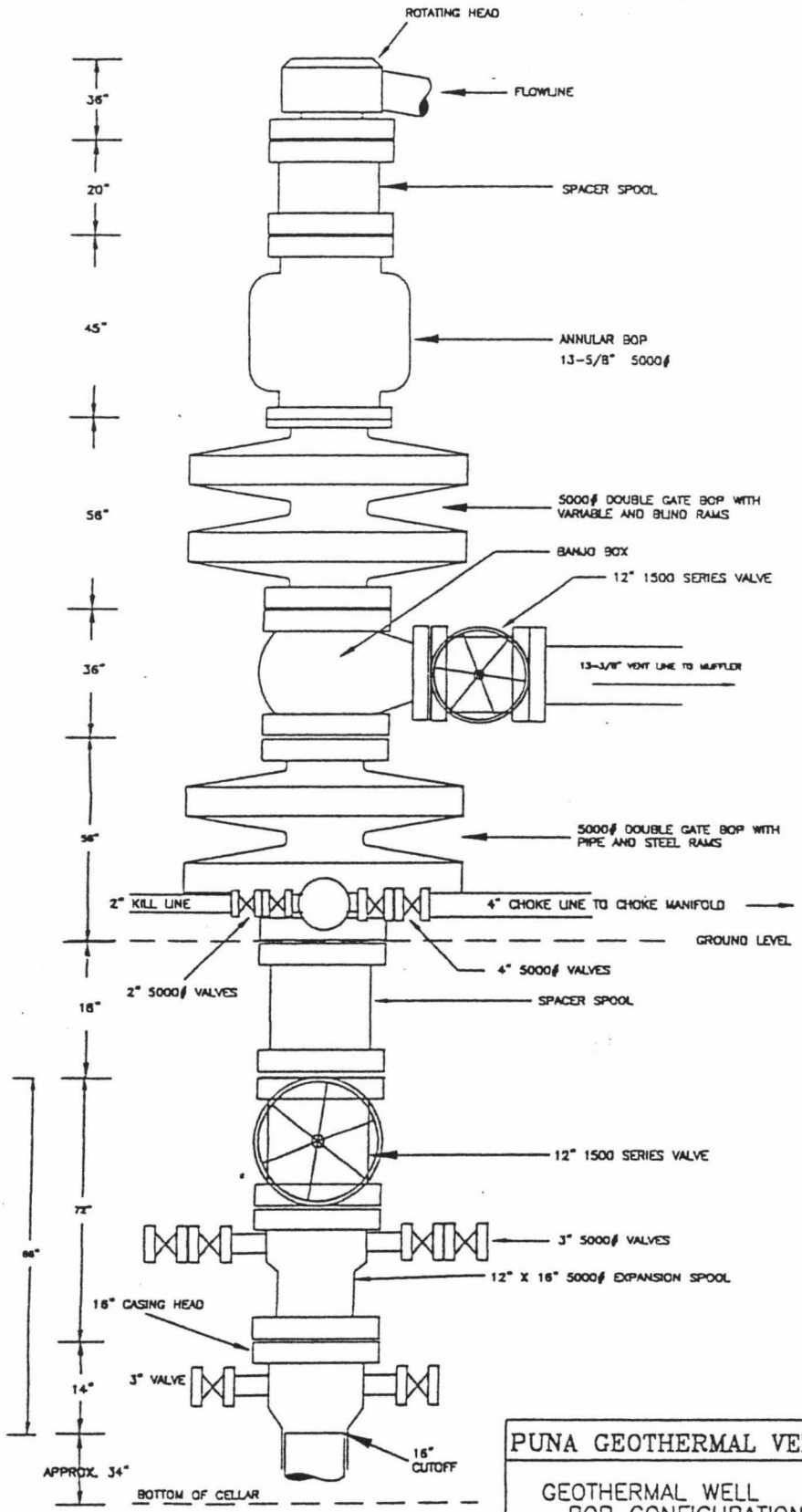
PUNA GEOTHERMAL VENTURE
PROPOSED KS-12 CASING SCHEMATIC
R. H. DENTON 3/6/02



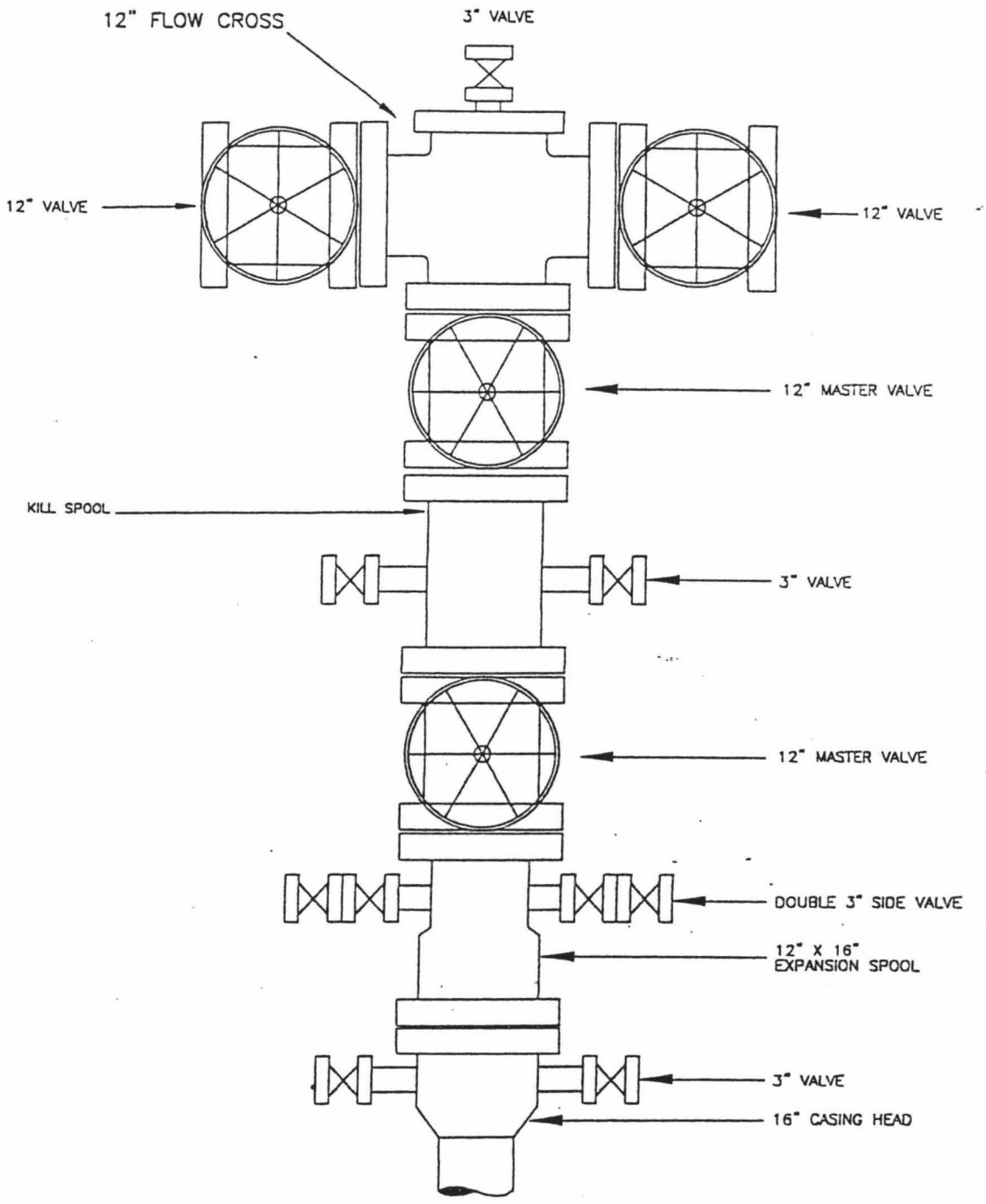
PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL 20" BOPE CONFIGURATION		
DATE 7/19/99		REV. 1
BY WM. TEPLOW	FILE:PGV\KS1180P20.DWG	FIGURE NO. 3-4



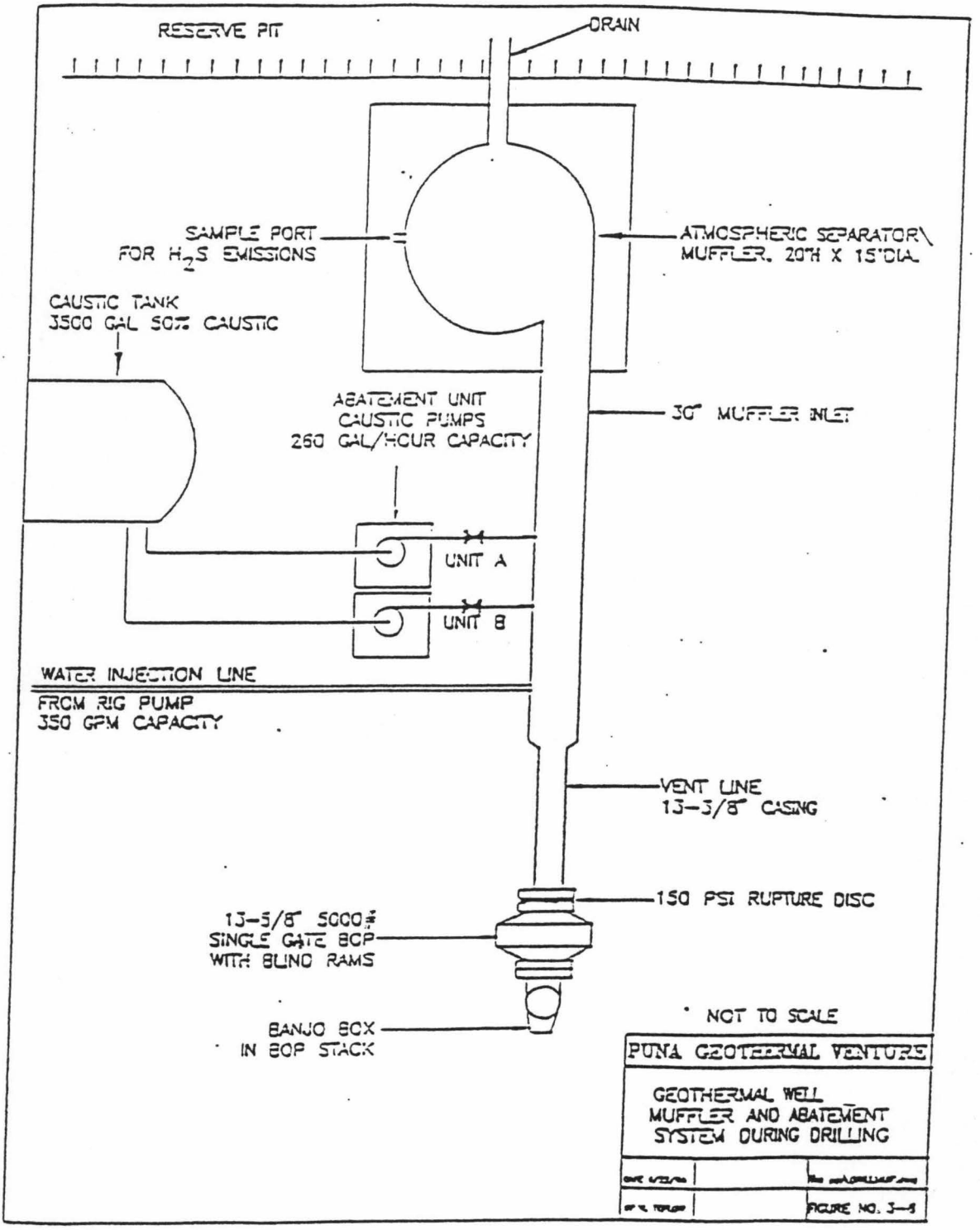
PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL BOP CONFIGURATION FOR 16" CASING		
DATE 7/20/99		REV. 2
BY TEPLOW	file: pgv\K11BOP16	FIGURE NO. 3-5



PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL BOP CONFIGURATION FOR 11-3/4" CASING		
DATE 7/20/98		REV. 2
BY WAL TEPLOW	file:pgv\ke11boe11.dwg	FIGURE NO. 3-6



PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELLHEAD CONFIGURATION		
DATE 7/13/98		REV. 1
BY WM. TEPLOW	FILE:PGV\KS11WH.DWG	FIGURE NO. 3-7


RESERVE PIT
DRAIN
SAMPLE PORT
FOR H_2S EMISSIONS
ATMOSPHERIC SEPARATOR\
MUFFLER, 20'H X 15'DIA.
CAUSTIC TANK
3500 GAL 50% CAUSTIC
ABATEMENT UNIT
CAUSTIC PUMPS
260 GAL/HOUR CAPACITY
30" MUFFLER INLET
UNIT A
UNIT B
WATER INJECTION LINE
FROM RIG PUMP
350 GPM CAPACITY
VENT LINE
13-3/8" CASING
150 PSI RUPTURE DISC
13-5/8" 5000#
SINGLE GATE BOP
WITH BLIND RAMS
BANJO BOX
IN BOP STACK
NOT TO SCALE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL
MUFFLER AND ABATEMENT
SYSTEM DURING DRILLING
FIGURE NO. 3-5

41269

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

March 15, 2002

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

SUBJECT: Kapoho State No. 5 (KS-5) and Kapoho State No. 12 (KS-12)
Drilling Permit Request

Dear Mr. Coloma-Agaran:

Puna Geothermal Venture (PGV) hereby requests Geothermal Drilling Permits for Kapoho State No. 5 (KS-5) and Kapoho State No. 12 (KS-12).

Our check for the filing fee of $200.00 is enclosed.

Should you have any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

for
Barry T. Mizuno
Owner's Representative

Enclosures

cc: M. Kaleikini/B. Wiebe
E. Tanaka

DEPARTMENT OF LAND AND NATURAL RESOURCES

DOCUMENT NO. _____ UAC OR ATTACHED WORKSHEET DATE: 4/02/02

F	YR	APP	D	SRC/ OBJ	COST CTR	PROJECT	PH	ACT	AMOUNT	NAME/DESCRIPTION (WANG INPUT)
G	00	000	C	1026	0742	------	--	---	(1) $200.00	Puna Geothermal Venture ROH #7870
-	--	---	-	----	----	------	--	---	(2)	Filing Fee for KS-5 & KS-12
-	--	---	-	----	----	------	--	---	(3)	
-	--	---	-	----	----	------	--	---	(4)	
									TOTAL $200.00	

REMARKS: LINE (1) _____

LINE (2) _____

LINE (3) _____

LINE (4) _____

04/02/02 *0022* CHECK 200.00

DEPARTMENT OF LAND AND NATURAL RESOURCES

DOCUMENT NO. _____ UAC OR ATTACHED WORKSHEET DATE: 4/02/02

F	YR	APP	D	SRC/ OBJ	COST CTR	PROJECT	PH	ACT	AMOUNT	NAME/DESCRIPTION (WANG INPUT)
G	00	000	C	1026	0742				(1) $200.00	Puna Geothermal Venture BOH #7870
									(2)	Filing Fee for KS-5 & KS-12
									(3)	
									(4)	
									TOTAL $200.00	

REMARKS: LINE (1) _____

LINE (2) _____

LINE (3) _____

LINE (4) _____

DETACH AND RETAIN THIS STATEMENT
THE ATTACHED CHECK IS IN PAYMENT OF ITEMS DESCRIBED BELOW.
IF NOT CORRECT PLEASE NOTIFY US PROMPTLY. NO RECEIPT DESIRED.

PUNA GEOTHERMAL VENTURE

DELUXE - FORM WVCY-3 V-2

DATE	DESCRIPTION	AMOUNT
3/15/02	#7870 - Filing Fee - KS-5 and KS-12 - 6150-8500	200.00

V-2

DELUXE - FORM WVCY-3 V-2

DATE	DESCRIPTION	AMOUNT
3/15/02	#7870 - Filing Fee - KS-5 and KS-12 - 6150-8500	200.00

V-2

STATE OF HAWAII

TREASURY DEPOSIT RECEIPT

FUND	DETAIL FUND OR APPROPRIATION	DATE
GENERAL	DIVISION OF WATER AND LAND DEVELOPMENT	4/02/02

SFX	TC	F	YR	APP	D	SOURCE/ OBJECT	COST CENTER	PROJECT NUMBER	PROJECT PH	DEPT. ACT	G/L ACCT.	S/L ACCT.	VENDOR NUMBER	VENDOR SFX	AMOUNT	
XX	XXX	X	XX	XXX	XX	XXXX	XXXX	XXXXXX	XX	XXX	XXX	XXXXXX	XXXXXXXXXX	XX	XXXXXXXXXX	XX
01	011	G	00	000	C	1026	0742								200	00

REFERENCE DOC NUMBER	REFERENCE DOC SFX	REV	VENDOR NAME	OPTIONAL DEPARTMENTAL DATA
XXXXXXXX	XX	X	X(30)	X(22)

REMARKS:

TOTAL DEPOSIT	200 00
KINDS OF DEPOSIT	
COIN	
CURRENCY	
CHECKS	
BANK DEPOSITS FHB	200 00
OTHERS	
TOTAL DEPOSIT	200 00

DISTRIBUTION COPIES

COPY #1 — STATE TREASURY

COPY #2 — STATE COMPTROLLER

COPY #3 — DEPARTMENT FISCAL OFFICE

COPY #4 — DEPARTMENT FISCAL OFFICE (FOLLOW-UP COPY)

LAND & NATURAL RESOURCES
DEPARTMENT

SIGNATURE OF AUTHORIZED PERSON

RECEIPT OF DEPOSIT HEREBY ACKNOWLEDGED BY FINANCE DIVISION, DEPT. OF BUDGET & FINANCE

SIGNED

4/15/02
DATE

DEPOSITORY'S NO.

107198

STATE ACCOUNTING FORM B-13
JULY 1, 1996 (REVISED)

...RTMENT FISCAL OFFICE (FOLLOW-UP COPY)

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT COLOMA-AGARAN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
ERIC T. HIRANO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

APR 10 2002

GEOTHERMAL WELL DRILLING PERMIT

Kapoho State 5 (KS-5)
Kapoho, Puna, Hawaii

TO: Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778-0030
(808) 965-6233

Your application dated March 15, 2002, for a permit to drill a geothermal well on land located within the Kapoho Section of the Kilauea Lower East Rift Geothermal Resource Subzone and covered under the State of Hawaii, Geothermal Resource Mining Lease No. R-2 is approved.

Well Designation:	Kapoho State 5 (KS-5)
Location:	TMK 1-04-01:02, Kapoho, Puna, Hawaii (Well Pad E)
Well Coordinates:	154° 53' 54" W 19° 28' 42" N
State Geothermal Mining Lease:	R-2
Leased to:	Kapoho Land Partnership
Subleased to:	Puna Geothermal Venture
Operator:	COSI Puna, Inc.
Ground Elevation:	619' Above Mean Sea Level
Projected Depth:	8,500' +/- True Vertical Depth

Approval is granted in accordance with the Department of Land and Natural Resources' (Department's) Administrative Rules, Chapter 13-183, Hawaii Administrative Rules (HAR), and under the following conditions:

(1) All work shall be performed in accordance with the permission and terms of the occupiers of the land, the Drilling and Completion Program submitted with your application, the Department's Administrative Rules (Chapters 13-183 and 13-184, HAR), and all other applicable Federal, State, and County laws, ordinances, rules and regulations;

(2) The permittee, its successors and assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury and death arising out of any act or omission of the applicant, assigns, officers, employees, contractors and agents under this permit or relating to or connected with the granting of this permit;

(3) The permittee shall observe and comply with all valid requirements of County, State, and Federal authorities and regulations to the land and permittee's operations including, but not limited to, all water and air pollution control laws and those relating to the environment;

(4) The well and bottom-hole location shall be located more than 100 feet from the outer boundary of the parcel of land on which the well is situated, or more than 100 feet from a public road, street or highway dedicated prior to the commencement of drilling, unless modified by the Chairperson upon request;

(5) The permittee shall notify the Department, in writing, of the date of the start of the drilling operations;

(6) Prior to drilling, the permittee shall submit to the Department the bottom-hole target location and the direction of any proposed deviation;

(7) All Blow-Out Prevention Equipment (BOPE) and cemented casing strings shall be pressure tested before commencing any other operations on the well. The minimum test pressures shall be approximately one-third of the casing internal yield pressure rating, providing the test pressure shall not be less than 600 psig nor greater than 2,500 psig, and shall be applied for a period of thirty minutes. The results of the pressure tests shall be reported on forms provided by the Department;

(8) Class "G" cement shall be used in the casing cementing operations and shall contain a high temperature resistant admix;

(9) A real time monitoring device shall be installed for the driller and a pit alarm system shall be included with this monitoring device. All toolpushers, drillers, and derrickmen shall be schooled in the use of the recommended monitoring equipment;

(10) If changes to the proposed drilling programs are contemplated, the permittee shall obtain the Chairperson's approval before executing such changes;

(11) When drilling has reached a depth of not more than 50 feet below sea level, the Department's representative shall be notified, with reasonable time allowed for travel to the site, to witness the retrieval of a representative ground water sample and the measurement of the static water level. The permittee shall have the sample analyzed by an independent laboratory and have the results submitted to the Department;

(12) A pressure and temperature survey, to inspect the mechanical integrity of the well, shall be performed after the well has been drilled to total depth, and before commencing the well cleanout flow or injection test;

(13) During the use of the well for testing, monitoring, production and/or injection purposes, the well and site shall be properly maintained until the well is plugged and abandoned in accordance with the Department's Administrative Rules, Chapter 13-183, HAR;

(14) The permittee shall submit to the Chairperson, the results of any exploration, all drilling and testing records, down-hole surveys of the well, bottom-hole location, date of completion, and a survey of the well location and elevation above mean sea level taken by a Hawaii licenced surveyor within six months after completion of the well;

(15) A well completion report, an as-built drawing of the well, and the location of the well plotted on a U.S.G.S. quad map shall be filed with the Department within six months after completion of the well;

(16) The bond covering the well shall remain in full force and effect until the well is properly abandoned and the surface is restored as near as possible to its original condition; and

(17) This permit shall expire 365 days from the date of issuance.

GILBERT COLOMA-AGARAN, Chairperson
Department of Land and Natural Resources

APR 10 2002
Date of Issuance

c: Land Board Members
Hawaii County Planning Department
Department of Business, Economic Development and Tourism
Department of Health
Office of Environmental Quality Control

APPLICATION FOR PERMIT TO DRILL
PROPOSED GEOTHERMAL WELL KAPOHO STATE 5
ON RESERVED LANDS, KAPOHO, PUNA, HAWAII

Complying with Department of Land and Natural Resources (DLNR) Administrative Rule, Title 13, Chapter 183, Section 65, Puna Geothermal Venture (PGV) herewith makes application for a Permit-to-Drill for approval by the Hawaii Board of Land and Natural Resources.

1. **Applicant:**

Puna Geothermal Venture
P.O. Box 30
14-3860 Kapoho Pahoa Road
Pahoa, Hawaii 96778-0030
(808) 965-6233

PUNA GEOTHERMAL VENTURE

By: _____
Barry T. Mizuno
Owner's Representitive
Puna Geothermal Venture

Owner of Mining Rights:

Kapoho Land Partnership

Land Owner:

Kapoho Land and Development Company, Limited

2. **Proposed Well Designation:**

Kapoho State 5 (KS-5) off Wellpad E.

3. A tax key map, designating the approximate location of the drill site for KS-5 off Wellpad E located on State Geothermal Mining Lease R-2; a topographic map, designating the approximate surface elevation at Wellpad E of 619 feet above mean sea level; and a PGV Project map, designating the relative locations of KS-5 and Wellpad E are contained in Attachment I.

4. The proposed PGV geothermal well KS-5 will be directionally drilled to a target area which lies at a horizontal distance of between approximately 400 feet and 2800 feet northerly of the KS-5 wellhead location, at a depth of between approximately 4000 feet and 8500 feet true vertical depth (TVD), and within the vertical boundary line of the leased property. The well will be drilled for the purpose of providing additional injection capacity for the disposal of PGV's spent geothermal fluid and gases, which is permitted under the Plan-of-Operation approved March 10, 1989, by the Board of Land and Natural

Resources. The target area is expected to be in fractured basalt with relatively low permeability and will provide injection capacity similar to that of KS-1A, KS-3 and KS-4

5. A detailed Summary-of-Drilling Procedures is enclosed in Attachment II.

6. A detailed Well Drilling and Completion Program, a drill site Plan, and a Vertical Section of the KS-5 well are contained in Attachment III.

7. A Summary-of-Drilling Reporting Criteria is enclosed in Attachment IV.

8. A description of Lithologic Logging Procedures is enclosed in Attachment V.

9. A multi-well drilling bond ($250,000) has previously been filed with the State of Hawaii.

10. Puna Geothermal Venture agrees to perform such drilling as outlined in this application and agrees to maintain the well in accordance with Title 13, Chapter 183, State of Hawaii, and all Federal and County geothermal regulations.

ATTACHMENT I

PUNA GEOTHERMAL VENTURE
APPLICATION TO DRILL KAPOHO STATE 5
A GEOTHERMAL WELL

I. General Information

a.	Well Designation:	Kapoho State 5
b.	Location:	TMK 1-04-1:02 Kapoho, Puna, Hawaii (Figure 1)
c.	State Geothermal Mining Lease:	R-2
d.	Owner of Mineral Rights:	Kapoho Land Partnership
e.	Subleased to:	Puna Geothermal Venture
f.	Operator:	COSI Puna, Inc.

II. Well Data

a.	Well Site:	Well Pad E (Figure 2)
b.	Well Map Coordinates:	154 53' 54" W 19 28' 42" N
c.	Well Type:	Development Well
d.	Surface Elevation:	619 feet AMSL (Figure 3)
e.	Projected Depth:	8500 feet True Vertical Depth (TVD)
f.	Target:	Fractured basalt below 4000' Measured Depth (MD)

Well will be directionally drilled to a target area which lies at a horizontal distance of between approximately 400 feet and 2800 feet northerly of the KS-5 wellhead location, at a depth of between approximately 4000 feet and 8500 feet TVD (Figure 2). The target is expected to be fractured basalt with relatively low-permeability which will provide injection capacity similar to that of KS-1A, KS-3 and KS-4.

III. Geology

Depth (MD):	Formation:
0 - 627 ft.	Unsaturated subaerial basalt flows and intercalated cinder scoria.
627 ft.	Water Table
627 - 3000 ft.	Saturated subaerial basalt flows and intercalated cinder scoria; rare dikes.
3000 - 4000 ft.	Interbedded hyaloclastite deposits and minor subaerial grading into submarine basalt flows; localized dike swarms.
4000 - 6500 ft.	Submarine basalt flows cross-cut by basalt dikes and possibly high-permeability, near-vertical fractures.
6500 - TD	Basaltic dike complex with locally recognizable submarine basalt flows.

ATTACHMENT II

PUNA GEOTHERMAL VENTURE
KS-5 DRILLING PROCEDURES
(Except as noted, all depths are referenced to KB.)

1. Move in suitable rig, air compressors and associated equipment.

   1.1 Notify DLNR 24 hours prior to rig up.
   1.2 Install sound proofing equipment.
   1.3 Install direct communication between rig floor, drilling contractor's supervisor and PGV's drilling supervisor.
   1.4 Driller, or qualified designee, will be on the rig floor at all times.
   1.5 Read, understand and comply with all parts of the Plan-of-Operations that pertain to drilling.
   1.6 Send copies of daily tower reports to DLNR.
   1.7 Adhere to attached Drilling Reporting Criteria, as per the Plan-of-Operations.

2. Make up 9½" mud motor on 17½" bit and 42" hole opener.

   2.1 Drill 42" hole to approximately 50 feet below ground level (GL). This may be accomplished prior to rig installation.
   2.2 Use approximately 2000 cfm of air and 30-35 gpm of stiff foam as needed.
   2.3 Set 30" conductor pipe and grout with approximately 10 cubic yards of ready mix.

3. Rig up 30" rotating head and flow line.

4. Drill 26" hole to approximately 650 feet.

   4.1 Use 9½" mud motor and 2000 cfm air and 30-35 gpm stiff foam as needed.
   4.2 Take a maximum reading thermometer (MRT) temperature every 90 feet, with directional surveys when below 500 feet.
   4.3 Catch 10-foot grab samples from drill cuttings and monitor hydrothermal alteration. See Attachment V for mud logging procedures.
   4.4 Check returns, if any, for salinity and chlorides.

5. At approximately 650 feet, rig up bailer and bail well until clean. Collect a representative sample of ground water.

   5.1 Notify DLNR 24 hours prior to sampling procedure.

6. Continue drilling 26" hole to approximately 1000 feet. Casing shoe will be set in low permeability rock below major lost circulation zones. The casing will be set if high temperatures or hydrothermal alteration is encountered.

   6.1 Keep hole as straight as possible.

6.2 Survey every 90 feet and run MRT.
6.3 If there are returns, then catch 30-foot grab samples from drill cuttings and monitor for hydrothermal alteration.
6.4 Check returns for increased salinity or chlorides.
6.5 Monitor well for flow or gases.
6.6 If the monitoring yields any evidence of proximity to a high-temperature geothermal zone, then increase sampling frequency and reduce drilling rate, as necessary, to evaluate conditions for setting casing.

7. Circulate hole clean.

8. Make wiper run.

8.1 Measure out of hole (strap out).
8.2 Keep hole full at all times.
8.3 Check for flow.
8.4 Circulate hole clean after wiper run.

9. Pull out of hole (POOH), keeping hole full, if possible, and checking for excess flow.

10. Rig up and run approximately 1000 feet of 20", 94#, K-55, Btc, casing equipped as listed below. Insert float shoe and flapper float one joint above casing shoe. Centralize 10 feet above casing shoe, first collar and every third collar thereafter.

10.1 Run casing at slow speeds to prevent down surge.
10.2 Fill casing with mud while running.
10.3 Keep hole full.
10.4 Plan length of casing string so that shoe is set 10 feet above total depth (TD).

11. Rig up 20" cementing head equipped with wiper plug.

11.1 Circulate hole clean.
11.2 Reciprocate casing 5-10 feet while circulating to prevent differential sticking.

12. Pump 50 ft^3 H_2O ahead followed by 100 ft^3 $CaCl_2$ H_2O mixed 10% plus 20 ft^3 H_2O plus 250 ft^3 Sodium Silicate plus 20 ft^3 H_2O. Pump 100 ft^3 Hawaii cement followed by 3040 ft^3 premixed Hawaii cement, 1:1 perlite with 40% SSA-1 plus 2% gel, 0.75% CFR-3 and 2% $CaCl_2$, followed by 300 ft^3 Hawaii cement mixed 40% SSA-1, 0.75% CFR-3 and 3% $CaCl_2$. Drop plug and displace cement.

12.1 Reciprocate casing 5-10 feet while cementing to prevent differential sticking.
12.2 Monitor returns and surface pressures throughout job.
12.3 Center casing and wait on cement (WOC).
12.4 Be prepared to do top job through 1" pipe with high density cement.
12.5 Have at least 20 cubic yards of sand, gravel, and/or volcanic cinders on hand to fill annulus through lost circulation zones, if required.

12.6 WOC minimum of 12 hours.
12.7 Perform top job as required.

13. Cut off casing and weld on 20" 5000# slip-on weld (SOW) casing head with 2 side outlets. Valve the outlets with 3" 5000# RTJ gate valves.

13.1 Test casing head and log on tower reports.

14. Install 20" annular preventer, 20" side outlet spool, diverter valve and line, and rotating head as shown in Figure 3-4. Install H_2S abatement equipment on diverter line.

14.1 Notify DLNR 24 hours prior to testing.
14.2 Test blow-out prevention equipment (BOPE) and have DLNR witness and approve (i.e., sign-off on IADC tower report).
14.3 Log test results on tower report and morning report.
14.4 Periodic BOPE drills will be conducted and logged on tower reports.
14.5 Install, test and run high efficiency mud cooler.
14.6 All personnel will have BOPE training. Training will be logged on the daily tower report.
14.7 All Supervisors, tool pushers and drillers will be certified, as appropriate.

15. Make up 17½" slick bottom hole assembly (BHA). Clean out cement.

16. Drill 5 feet of new 17½" hole and circulate clean.

17. Perform leak-off test and squeeze, if necessary.

17.1 Notify DLNR 24 hours prior to testing.
17.2 Have DLNR witness and approve leak-off test.

18. Make up BHA and drill 17½" hole to approximately 2000 feet.

18.1 Keep hole straight.
18.2 Survey every 90 feet and run MRT.
18.3 Catch 30-foot grab samples of drill cuttings.
18.4 Check mud for increased salinity and chlorides.
18.5 Monitor well for increases or decreases in flow rates and gases.
18.6 Keep close watch on samples for changes in mineralogy indicative of a high-temperature geothermal reservoir.
18.7 If the monitoring of returns yields any evidence of proximity to a high-temperature geothermal zone, then increase sampling frequency appropriately.
18.8 Cement off loss circulation zones.
18.9 Be prepared to set casing if there are any signs of encountering a high-temperature reservoir.

19. Circulate hole clean and make wiper trip to shoe. Circulate hole clean.

20. POOH

20.1 Measure out of hole (strap out).
20.2 Keep hole full.
20.3 Monitor well and be sure well takes proper amount of fluid.

21. Rig up and run approximately 2000 feet of 13 ⅜", 68# or 72#, K-55, premium thread casing equipped as listed below. Place float shoe and float collar 2 joints above casing. Centralize 10 feet above casing shoe, on first, second and third collar. Centralize every third collar thereafter.

21.1 Use safety collars while running casing.
21.2 Use thread protectors.
21.3 Use Stab-in guides, if available.
21.4 Run casing at slow speeds to prevent down surge.
21.5 Fill casing with mud while running.
21.6 Monitor well.
21.7 Keep hole full.
21.8 Have casing sized to remain 10 feet off the bottom.

22. Rig up and run 5" drill pipe with screw-in sub.

22.1 Screw into float collar.
22.2 Be sure casing is full of mud.
22.3 Circulate and condition hole for cement job.
22.4 Observe casing and drill pipe annulus to be sure stab-in is not leaking.
22.5 Reciprocate casing while circulating to prevent differential sticking.

23. Pump 50 ft^3 H_2O ahead followed by 50 ft^3 $CaCl_2$ H_2O and 133 ft^3 Sodium Silicate, and 10 ft^3 H_2O. Pump 50 ft^3 Hawaii cement followed by 3000 ft^3 Hawaii cement, mixed 1:1 perlite with 40% SSA-1 plus 2% gel 0.65% CFR-3 and retarded, as required, followed by 300 ft^3 Hawaii cement with 40% SSA-1 0.75% CFR-3. Drop plug and displace cement.

23.1 Reciprocate casing 5-10 feet while cementing.
23.2 If casing becomes excessively sticky during cementing phase, then place casing at proper position and centralize.
23.3 Monitor returns and pressures throughout job.
23.4 Be prepared for top job.

24. WOC at least 12 hours.

25. Cut off casing and install 13 ⅜" SOW x 13 ⅝" 5000# casing head, using Hot Head or comparable pre-heat/post-heat service.

26. Install 13 ⅝" 5000# mud cross, 13 ⅝" 5000# double gate, 13 ⅝" 5000# banjo box or flow tee or equivalent with rupture disk and single gate, 13 ⅝" 5000# double gate, 13 ⅝" 5000# annular preventer, rotating head, choke and kill lines, blooie line and muffler. Also include water lines and abatement lines, as per Figure 3-8 in Attachment III. Install and check all monitoring equipment, including driller assistant.

    26.1 Notify DLNR 24 hours prior to test.
    26.2 Test BOPE and have DLNR witness and approve (i.e., sign-off on IADC tower report).
    26.3 Log test results and approval of test on tower report and morning report.
    26.4 All pushers, drillers and derrick men will be trained in the use of appropriate monitoring equipment, and this training will be logged in International Association of Drilling Contractors (IADC) tower report.

27. Use 12¼" bit with slick BHA and clean out cement and floats.

28. Drill approximately 5 feet of new hole and circulate hole clean.

29. Perform leak-off test and squeeze cement, if necessary.

    29.1 Notify DLNR 24 hours prior to testing.
    29.2 Have DLNR witness and approve leak-off test (i.e., sign-off on IADC tower report).

30. POOH. Make up 12¼" bit and tools. Drill 12¼" hole to approximately 3900 feet. Casing point will be in the cap rock above the reservoir as determined by the wellsite geologist using criteria described in the Plan-of-Operations.

    30.1 Do directional work and drill 12¼" hole to approximately 3900 feet. See directional program.
    30.2 Survey every 120 feet and run MRT.
    30.3 Catch 30-foot grab samples of drill cuttings.
    30.4 Keep close watch on mud properties.
    30.5 Monitor well for increases or decreases in flow rates and gases.
    30.6 Keep close watch on samples for changes in mineralogy indicative of a high-temperature geothermal reservoir.
    30.7 If the monitoring of returns yields any evidence of proximity to a high-temperature geothermal zone, then increase sampling frequency and frequency of MRT appropriately.
    30.8 Cement off lost circulation zones.

31. Circulate hole clean and wipe hole to shoe. Circulate hole clean.

32. POOH and rig up to run 9 ⅝" liner on liner hanger, providing 200 linear feet of lap. Equip liner as follows. Place float shoe and float collar approximately 80 feet up from

casing shoe. Centralize liner 10 feet up from the casing shoe, on 1st, 2nd, 3rd and every 4th collar thereafter, or as per program. Liner hanger is to have tie-back capability.

32.1 Make up liner hanger prior to running the liner and stand liner hanger assembly up in the derrick.
32.2 Run approximately 2100 feet of 9 ⅝", 47#, C-90, premium thread casing.
32.3 Use safety collars while running casing.
32.4 Run casing at slow speeds to prevent down surge on formation.
32.5 Fill casing while running.
32.6 Keep hole full.
32.7 Monitor well closely.
32.8 Be cautious of slips on the liner hanger when running through BOPE.
32.9 Run and hang liner and break nut.

33. Rig up and circulate hole clean and condition mud for cement job.

34. Pump 50 ft^3 H_2O ahead plus 133 ft^3 foamed flow check, and 10 ft^3 H_2O followed by foamed Hawaii cement with 40% SSA-1, required additives, and retarded as needed, followed by 85 ft^3 Hawaii cement with 40% SSA-1 + 0.65% CFR-2. Drop dart and displace cement.

34.1 Monitor well closely while cementing.

35. Release liner and strip out of hole approximately 200 feet using annular preventer to keep pressure on annulus constant.

36. WOC for minimum of 4 hours. POOH. WOC an additional 8 hours.

37. Run in hole (RIH) with 12¼" bit and clean out cement to top of liner hanger.

38. Make up 8½" bit and clean out liner hanger.

39. Test liner lap to 0.9 psi/ft. gradient. Squeeze cement and retest, if necessary.

40. Make up stab-in for tie back receptacle and approximately 1800 feet of 9 ⅝", 47#, C-90, premium thread casing, equipped with insert float on top of 1st joint and centralized with positive centralizers on 1st, 2nd and every 3rd collar thereafter with positive centralizers.

40.1 Size casing so collar will not be in expansion spool packoff.

41. Circulate hole clean.

41.1 Install centering ring.

42. Pump 50 ft^3 H_2O ahead followed by 970 ft^3 Hawaii cement with 40% SSA-1 + 0.65% CFR-3 + 3% gel. Drop plug and displace to insert float.

43. WOC 16 hours.

44. Cut off casing and install expansion spool with donut hanger. Test with nitrogen.

45. Install BOPE stack for 9 ⅝" casing including master valve (Figure 3-6).

    45.1 Notify DLNR 24 hours prior to testing BOPE.
    45.2 BOPE to be tested to 2500 psi.
    45.3 Test to be witnessed and approved by DLNR.

46. Clean out casing and drill approximately 5 feet of new 8½" hole.

    46.1 Circulate hole cleaner.
    46.2 Perform leak-off test and squeeze, if necessary.
    46.3 Notify DLNR 24 hours prior to testing.
    46.4 Have DLNR witness and approve leak-off test.

47. Drill 8½" hole to approximately 8500 feet TVD or until sufficient injection permeability is encountered.

    47.1 Survey every 120 feet and run MRT.
    47.2 Catch 10-foot grab samples of drill cuttings.
    47.3 Keep close watch on mud properties. Weight up as needed to control well.
    47.4 Be sure all monitoring equipment is in good working order.
    47.5 Watch closely for flow or loss.
    47.6 Watch closely for changes in mineralogy indicative of high-temperature geothermal reservoir.

48. At TD circulate hole clean.

    48.1 Displace mud with water or completion fluid and POOH.

49. Perform preliminary flow test to muffler to clean out well. Run necessary surveys to confirm mechanical integrity.

50. If needed to maintain hole stability, run 7-inch perforated liner from 100 feet above the 9 ⅝' casing shoe to TD.

51. Lay down drill pipe and tools.

52. Perform injection test and surveys to inspect mechanical integrity of well.

53. If required, run 7-inch hangdown string and hang from donut hanger at surface to within approximately 100 feet of the top of the 7-inch perforated liner.

54. Secure well.

55. Install companion flange and swab valve.

56. Rig down and move rig.

ATTACHMENT III

PUNA GEOTHERMAL VENTURE
DEVELOPMENT WELL DRILLING PROGRAM
FOR WELL KS-5

CONDUCTOR CASING AND CELLAR:

A 30" conductor pipe will be set in a 42" hole that was drilled to a depth of 50 feet below ground level. The conductor is to be cemented in place with a Portland cement concrete, or equivalent, placed down the backside of the 30" conductor pipe.

Following the setting of the conductor pipe, dig an earthen cellar and construct a reinforced concrete cellar according to civil contractor's design and specifications (Figure 3-1).

DRILLING - 26" HOLE:

Rig up a suitable drilling rig as shown in Figure 3-2. Weld on 30" pitcher nipple. Spud in with 26" bit. Anticipate losing total returns at any time below surface. Continue drilling ahead on water, aerated mud or foam without returns. Run maximum reading thermometer (MRT) during directional surveys every 90 feet below a depth of 500 feet. Drill to a depth of 650 feet.

At this depth rig up bailer and bail continuously or as required to get a representative ground water sample. Collect samples and send to lab for analysis. Have DLNR witness sampling procedure. Notify DLNR 24 hours prior to taking samples.

Resume drilling 26" hole on water, aerated mud, or foam. Drill to a depth of approximately 1000 feet, the casing point for 20" casing. If abnormal temperatures are encountered, notify the drilling superintendent and stop drilling. The 20" casing may be set at that point after consulting with and receiving permission from Department of Land and Natural Resources (DLNR).

SURFACE CASING:

Approximately 1000 feet of 20", 94#, K55, Btc casing will be run and cemented in place (Figure 3-3). Run casing while filling on every second joint.

Cement 20" casing through drill pipe with Hawaii cement + 40% silica flour + 2% calcium chloride + 0.65% CFR-3. Excess is calculated at 100%. Reciprocate casing 5–10 feet throughout job.

Wait on cement for 12 hours. Have at least 200 cubic yards of sand, gravel, and/or volcanic cinders on hand.

Pick up and run 1" tubing down backside of 20" casing. Tag fill. Mix and pump Hawaii cement + 40% silica flour + 2% calcium chloride + 0.65% CFR-3. Circulate to surface. Pull tubing and wash while laying it down. Wait on cement for 12 hours. Should the cement settle, top out with

batched ready-mix poured down the backside of the 20" casing. Ready-mix can be accelerated with 2% by weight of calcium chloride. Wait on cement for 12 hours.

BLOWOUT PREVENTION EQUIPMENT (20-inch BOPE) 17½" HOLE (Figure 3-4):

Cut off casing and weld on 20" 5000# SOW casing head with 2 side outlets. Valve the outlets with 3" 5000# RTJ gate valves.

Blowout prevention equipment to drill a 17½" hole shall consist of a 20" 5000# annular preventer and diverter system as shown in Figure 3-4. Test BOPE per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing.

DRILLING 17½" HOLE:

Drill out from underneath the 20" surface casing with mud. Make up a 17½" mill tooth bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent of 11#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Drill out and trip for bottom hole assembly.

Should lost circulation persist, loss interval(s) should be cemented.

The 17½" hole is to be drilled to a depth of approximately 2000 feet where 13" casing is to be run.

INTERMEDIATE CASING:

Approximately 2000 feet of 13 ⅜", 68# or 72#, K55, premium thread casing is to be run and cemented in place in a single stage (Figure 3-3).

Cement with Hawaii cement + 40% silica flour + 0.65% CFR-3. If losses are encountered below the 20" casing shoe, it may be advisable to cement the 13" string with a light weight cement slurry tailed by 200 sacks of tail slurry. Pump 60% excess.

BLOWOUT PREVENTION EQUIPMENT (13" BOPE) - 12¼" HOLE (Figure 3-5):

Cut off casing and install 13 ⅜" SOW X 13" 5000# casing head. Blowout prevention equipment to drill a 12¼" hole will consist of two 13" 5000# double gate preventers, a 13" 5000# annular preventer, a banjo box with rupture disk and single gate preventer on the side outlet with blind ram inserts, a rotating drilling head, choke, and kill line (Figure 3-5). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment on blooie line (Figure 3-8).

DRILLING 12¼" HOLE:

Drill out the shoe with a 12¼" bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent to 11#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Squeeze if required. Trip for bottom hole assembly. Drill to casing point at approximately 3900 feet.

INJECTION CASING:

Approximately 3900 feet of 9 ⅝" 47#, C-90, premium thread casing is to be run and cemented (Figure 3-3). Cement casing with Hawaii cement + 40% silica flour + 50 lb/sk of spherelite + 4% gel + 1.25% CFR-3 + 1.5% HALAD 22A. Excess is calculated at 60%. After WOC, cut off the 9 ⅝" casing. Dress casing 8" above casing head flange with 27½ degree chamfer. Nipple up 13 ⅝" 5000# x 10" 5000# expansion spool with packing sleeve.

BLOWOUT PREVENTION EQUIPMENT (9-5/8" BOPE) - 8½" HOLE (Figure 3-6):

Blowout prevention equipment to drill the 8½" section of hole should consist of a 10" 5000# gate valve, 10" 5000# x 13" 5000# double-stud adapter (DSA), two 13" 5000# double gate preventers, a 13" 5000# annular preventer, a banjo box with a rupture disk and a single-gate preventer on the side outlet, a rotating drilling head, choke, and kill line (Figure 3-6). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment and muffler on choke line. Provisions will be made to abate any well flow from the choke line or the blooie line.

DRILLING 8½" HOLE:

Drill out from underneath the 9 ⅝" casing on water with an 8½" bit and slick bottom hole assembly. Perform leak-off test and note test results on IADC tower report. Squeeze if required. Notify appropriate State agencies 24 hours prior to testing. Trip for packed BHA and continue drilling ahead on mud.

Should differential sticking occur, rig up the air compressor and circulate with air to free the stuck string.

At total depth (TD) circulate out mud with fresh water. Trip-out of hole and rig up flow test. If test is successful, run perforated liner, if required to keep the hole open.

INJECTION LINER

Trip in hole with slick BHA and check for fill. If hole is opened, run approximately 3800 feet of 7", 29#, L-80, Btc perforated casing. Run liner with cement guide shoe on bottom and hang on 7" x 9 ⅝" single slip cone type liner hanger (Figure 3-3). Release from hanger and trip out laying down.

Nipple down BOP and install final wellhead for injection well as shown in Figure 3-7. An optional 7" tie back injection liner may be installed. Run approximately 3700 feet of 7", 29#, SM-22, casing and hang on donut type hanger set in top of 10" X 13 ⅝" expansion spool (Figure 3-3).

ATTACHMENT IV

PUNA GEOTHERMAL VENTURE
DRILLING REPORTING CRITERIA

1. The Drilling Supervisor shall report to the PGV Drilling Engineer or his designated relief on the day-to-day operations.

2. As closely as possible, the Drilling Supervisor will follow the drilling program for a particular well as provided by the Drilling Engineer. There will be changes in the drilling program as the well progresses, and these changes must be discussed with the Drilling Engineer before action is taken.

3. Approximate casing setting depth will be set in the Drilling Program with assistance from the Geologist. These depths should be used absent other information A mud program will be outlined in the Drilling Program, and this program should be followed as closely as possible. The Drilling Supervisor shall have ample latitude to change the mud program as dictated by the actual drilling conditions.

4. Historical drilling data have been developed regarding the Puna Geothermal Project, and this data should be used to the best advantage in drilling wells within the project.

5. In and out mud temperatures and maximum recording temperatures will be logged on the IADC tower report.

6. When drilling below the 13 ⅜" casing shoe, special precautions must be taken when encountering any lost circulation zones or drilling breaks.

7. If a drilling break is encountered while drilling, then the Kelly should be picked up and bottoms up should be circulated around. The PGV Drilling Supervisor should be immediately notified along with the contractor's supervisor. A temperature survey should be run whenever a drilling break is encountered. An interpretation of the survey should be made by the Drilling Engineer before drilling further. It is important not to drill ahead with excessive temperature in the mud returns.

8. The driller should also note in the IADC tower report any gains or losses in the mud pit volume. Any significant mud loss should be reported to the PGV and the Contractor's supervisors. If any continuous or significant mud gain is encountered, the driller should pick up the Kelly and check for flow and notify the supervisors. If flow is observed, then the well will be shut in immediately.

9. Based on past experience at the Puna Geothermal Project, it is imperative that constant supervision of the well be accomplished once drilling is undertaken below the 13 ⅜" casing shoe.

10. PGV Supervisors will be in charge of all activities on location. PGV Supervisors will report to the PGV Drilling Engineer.

11. Drilling Supervisors will spend sufficient time together at the rig during change-out to exchange information on the current activities. Drilling Supervisors will be on the floor, on the pump truck, in the wireline unit, etc. for all critical operations.

12. The Drilling Engineer will be responsible for engineering programs with input from the Drilling Supervisors. The Drilling Engineer will also advise and assist the Drilling Supervisors.

13. Contractor's supervisors will report to the Drilling Supervisor on location. They will also be on the floor during all crew changes.

14. Reporting procedures for crews will be the responsibility of the drilling contractor. Drillers will log all rig operations on the IADC daily tower report, including the depths of all work performed. Rig crew will assist service company personnel as directed by the contractor's supervisor.

ATTACHMENT V

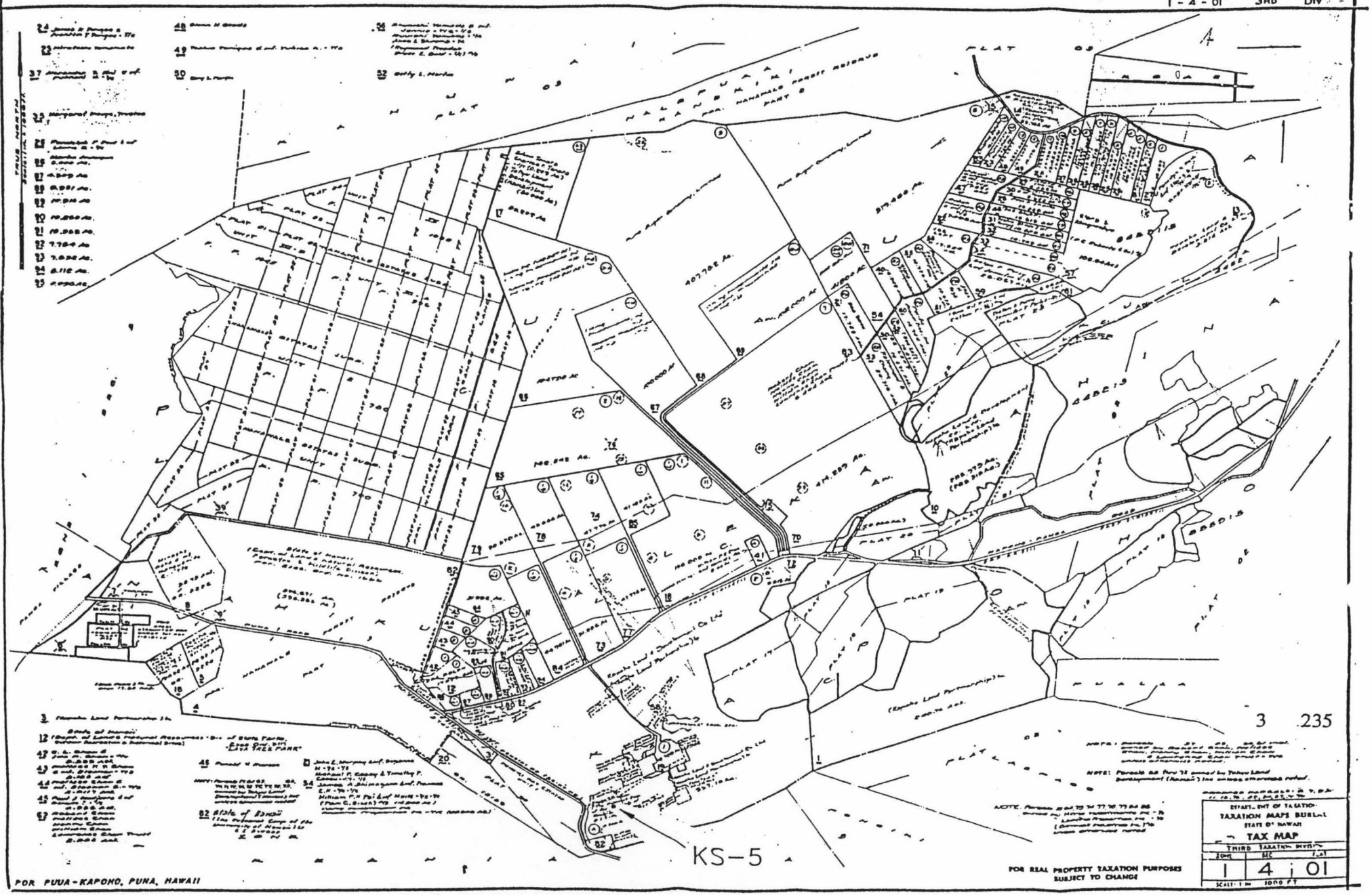
PUNA GEOTHERMAL VENTURE
PROCEDURES FOR LITHOLOGIC LOGGING

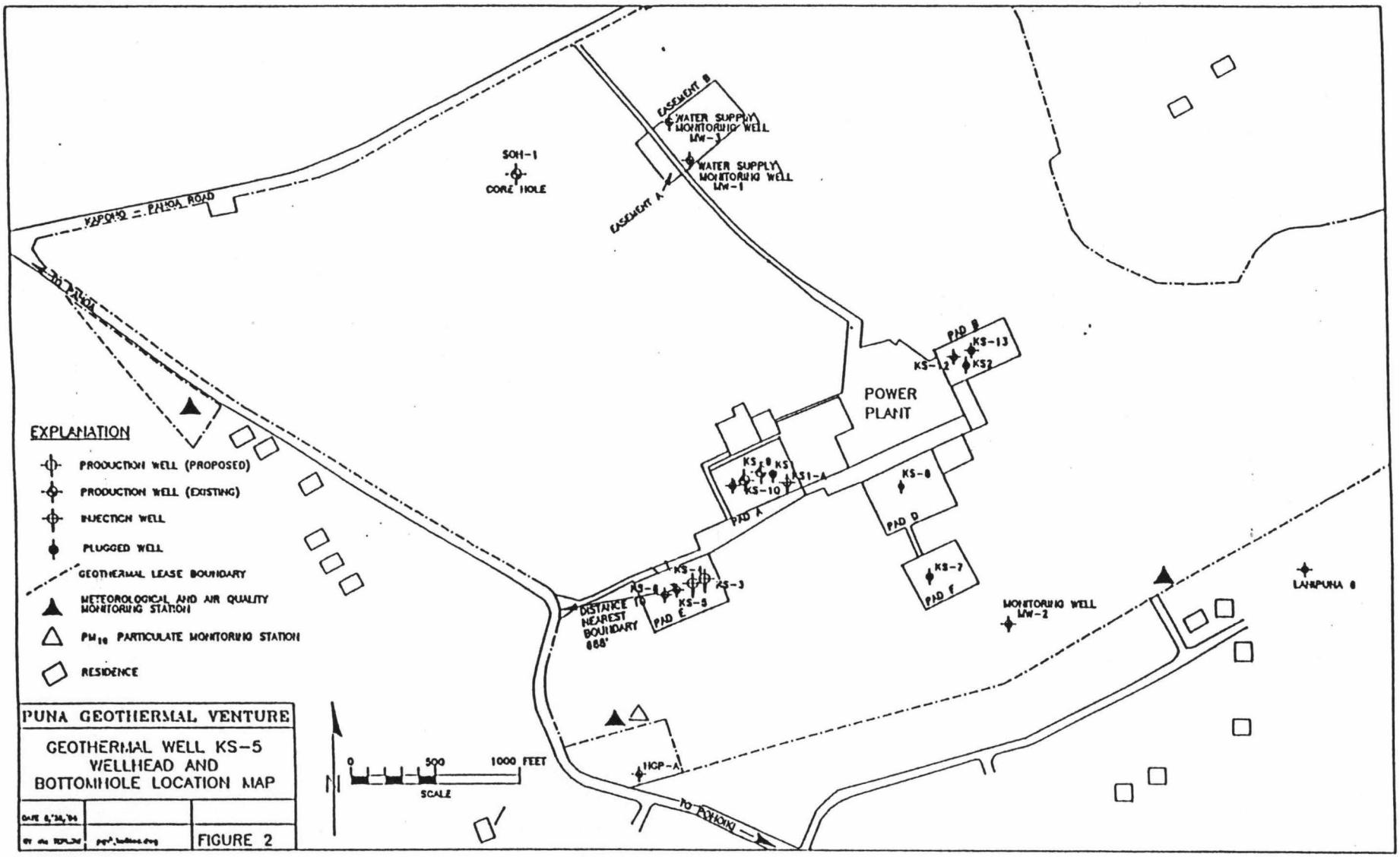
While drilling, depths are recorded on a Bristol chart (a circular chart matching time versus depth). As a single joint is drilled, each ten-foot interval (i.e., 100, 110, 120, etc.) is marked and labeled on the chart. A lag time (the interval of time, measured in minutes, required to circulate drilling fluids from the bit to the surface) is calculated based on hole size and pump rates and a marker is set to indicate when a marked depth reaches the surface.

When drilling fluids containing suspended drill cuttings derived from a given interval reach the surface, it travels down the flow line and over the mesh shaker screens. After the latest ten-foot interval has accumulated at the base of the shakers, the mud logger obtains a representative sample of the drill cuttings. The sample is then washed of the drilling fluid. One portion of the cuttings, the wet sample, is placed in a plastic bag and the remainder is dried and bagged in sample sets.

A small amount is retained to view under a stereomicroscope. The cuttings from each ten-foot interval are then visually and physically evaluated. Detailed written descriptions of each ten-foot interval are entered on work sheets which are subsequently summarized onto the mud log data sheet. The lithologic descriptions includes rock type, color, texture, hardness, structural characteristics, alteration (if any) and secondary mineralization.

FIGURE 1


1 - 4 - 01
3RD DIV
KS-5
3 .235
POR PUUA-KAPOHO, PUNA, HAWAII
FOR REAL PROPERTY TAXATION PURPOSES
SUBJECT TO CHANGE
DEPT. OF TAXATION
TAXATION MAPS BUREAU
STATE OF HAWAII
TAX MAP
THIRD TAXATION DIVISION
ZONE 1
SEC 4
PLAT 01
SCALE 1 in 1000 FT


EXPLANATION
PRODUCTION WELL (PROPOSED)
PRODUCTION WELL (EXISTING)
INJECTION WELL
PLUGGED WELL
GEOTHERMAL LEASE BOUNDARY
METEOROLOGICAL AND AIR QUALITY MONITORING STATION
PM_{10} PARTICULATE MONITORING STATION
RESIDENCE
SOH-1
CORE HOLE
EASEMENT B
WATER SUPPLY MONITORING WELL MW-3
WATER SUPPLY MONITORING WELL MW-1
EASEMENT A
POWER PLANT
PAD B
KS-13
KS-12
KS2
KS-10
KS1-A
KS-6
PAD A
PAD D
KS-7
PAD F
KS-4
KS-8
KS-3
KS-9
PAD E
DISTANCE TO NEAREST BOUNDARY 668'
MONITORING WELL MW-2
LANIPUNA 8
HGP-A
0
500
1000 FEET
SCALE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL KS-5
WELLHEAD AND
BOTTOMHOLE LOCATION MAP
FIGURE 2

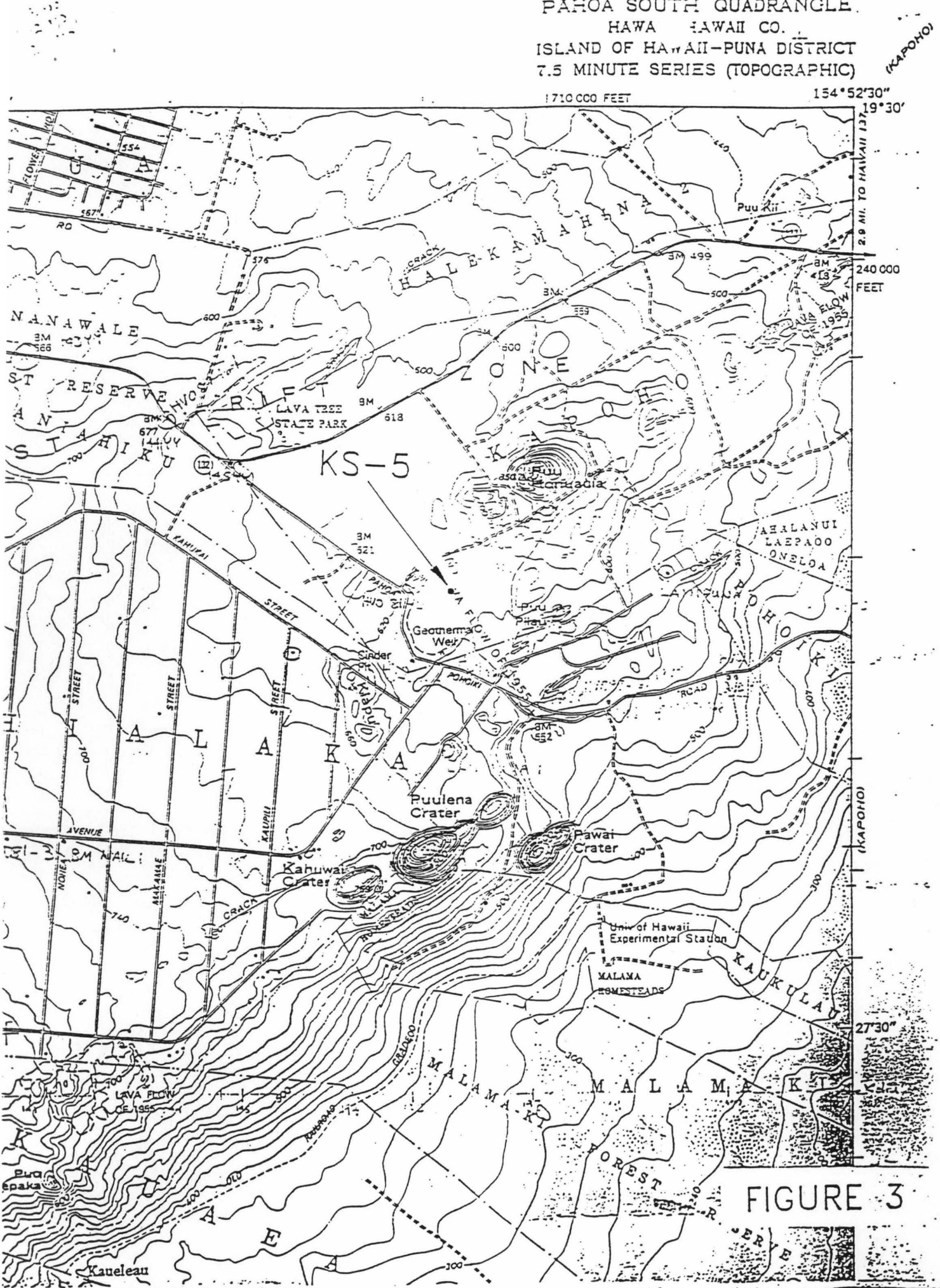
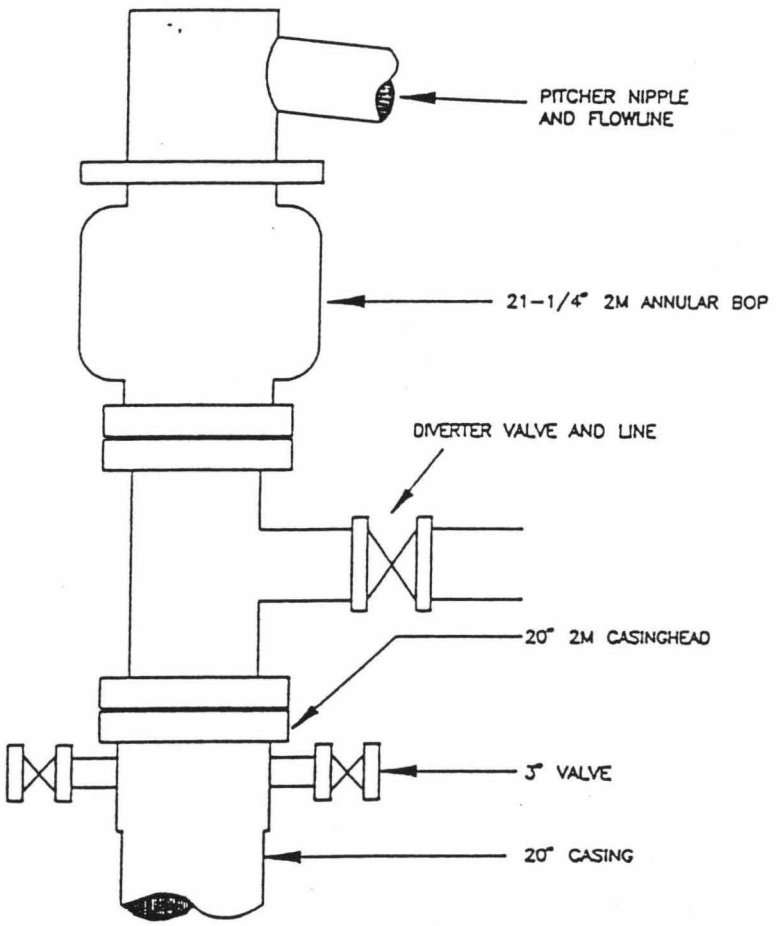

PAHOA SOUTH QUADRANGLE
HAWAII CO.
ISLAND OF HAWAII—PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)
1710 000 FEET
154°52'30"
19°30'
240 000 FEET
27'30"
KS-5
KAPOHO
Puu Kii
Puu Heiau
Puu Honuaula
Puu Pua
Geothermal Well
Cinder
Puulena Crater
Pawai Crater
Kahuwai Crater
Univ of Hawaii Experimental Station
MALAMA HOMESTEADS
LAVA TREE STATE PARK
LAVA FLOW OF 1955
Kauleleau
Puu Kapaka
HALEKAMAHINA
NANAWALE
KAPOHO
PUNA
MALAMA KI
FOREST RESERVE
KAUKULAU
ONELOA
KAHUMAI STREET
KAUPILI AVENUE
POHOIKI ROAD
KAPOHO (KAPOHO) 2.9 MI. TO HAWAII 137

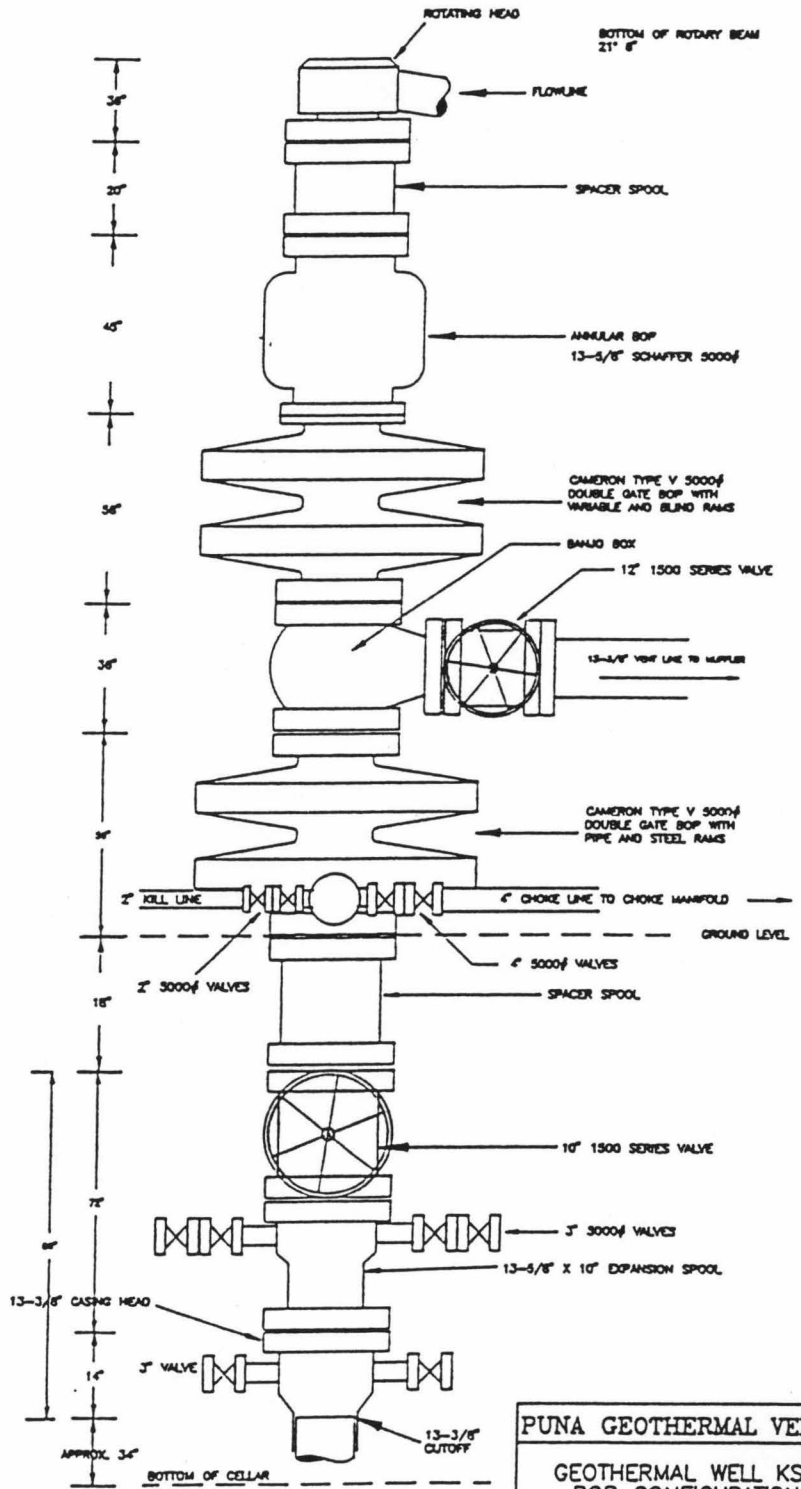
FIGURE 3



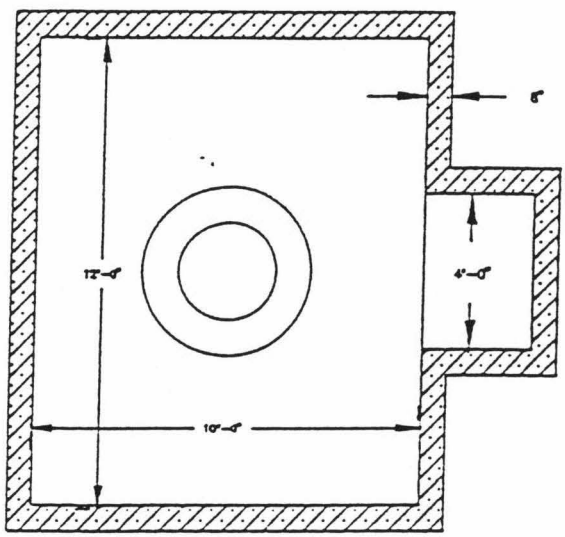
PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL KS-5
20" BOP
CONFIGURATION

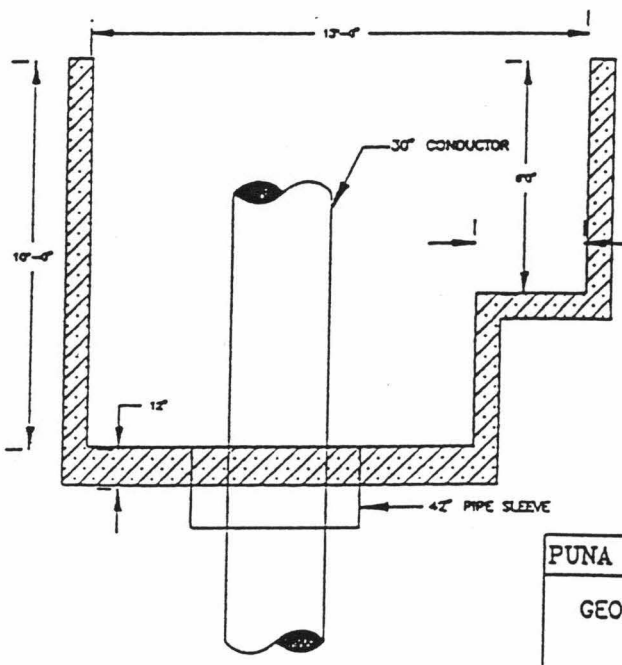
DATE 6/23/94		REV. J
BY TOFLOW	FILE: PGV\K118OP20.DWG	FIGURE NO. J-4



PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL KS-5 BOP CONFIGURATION FOR 9-5/8" CASING		
DATE 6/23/94		REV. 2
BY TEPLOW	file: pgv\ks11bop8.dwg	FIGURE NO. 3-8



PLAN

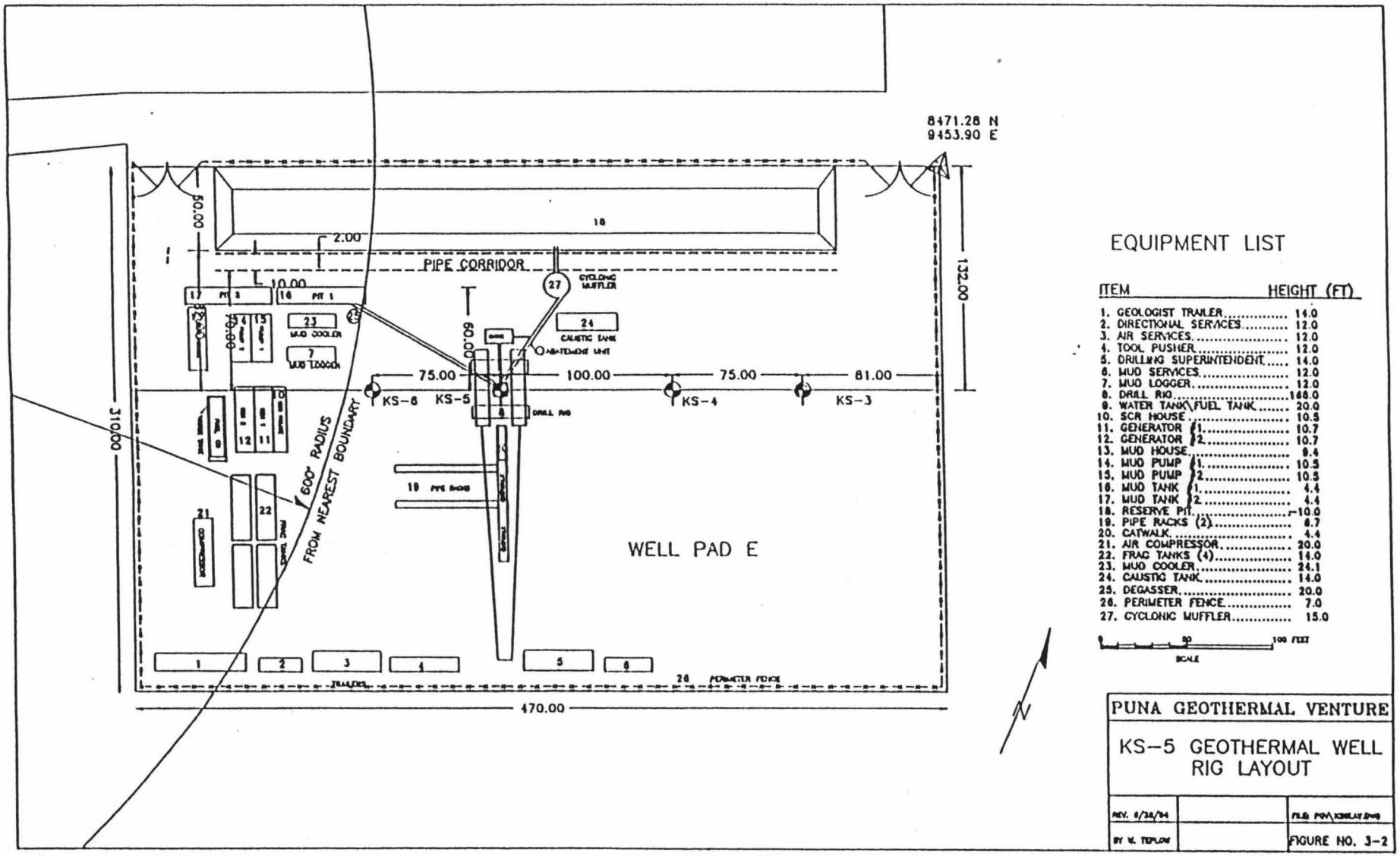


VERTICAL SECTION

PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL KS-5
WELL CELLAR

DATE 6/28/84		file: pgv\cellar.dwg
BY W. TAYLOR		FIGURE NO. 3-1



EQUIPMENT LIST

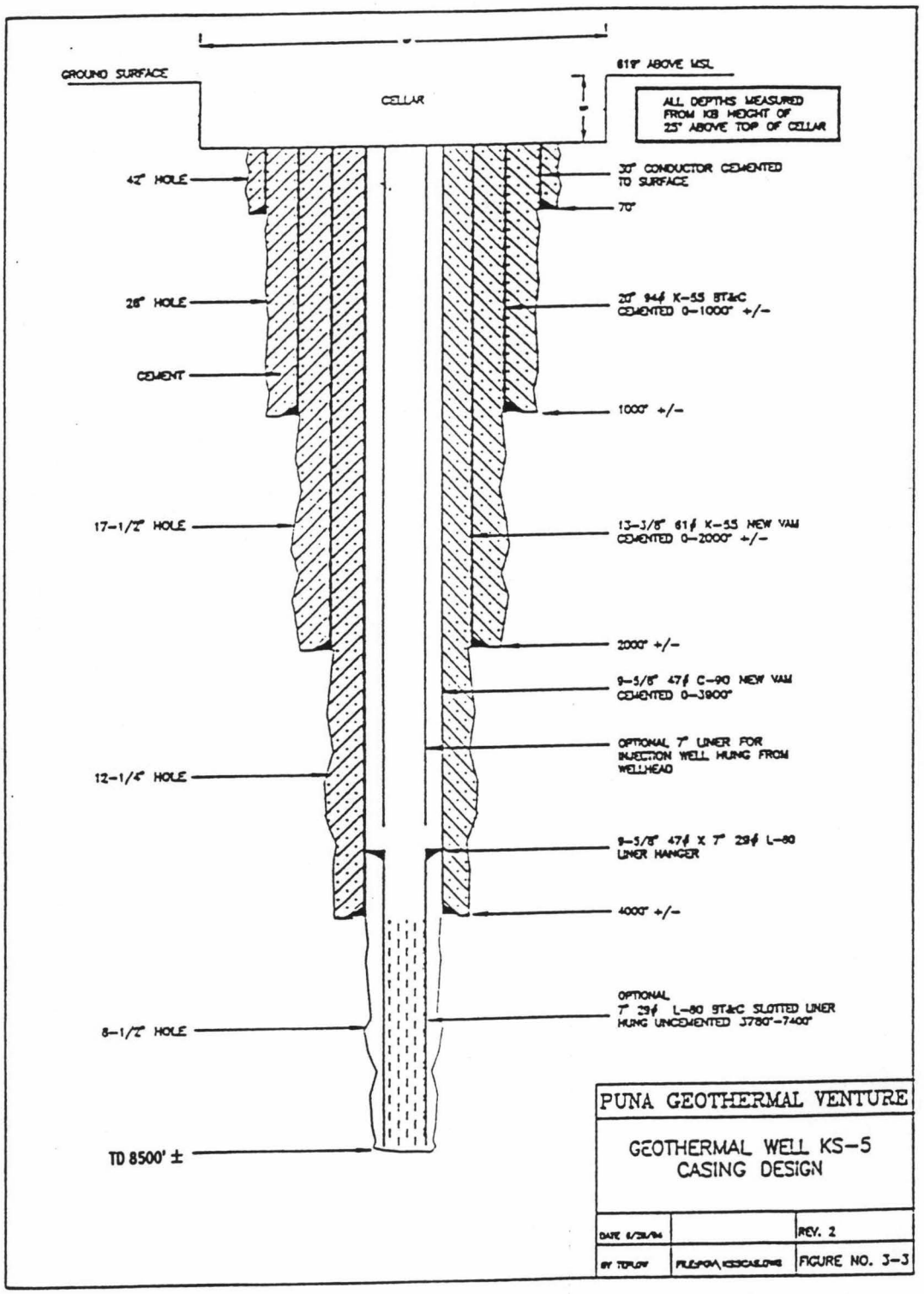
ITEM	HEIGHT (FT)
1. GEOLOGIST TRAILER	14.0
2. DIRECTIONAL SERVICES	12.0
3. AIR SERVICES	12.0
4. TOOL PUSHER	12.0
5. DRILLING SUPERINTENDENT	14.0
6. MUD SERVICES	12.0
7. MUD LOGGER	12.0
8. DRILL RIG	168.0
9. WATER TANK\FUEL TANK	20.0
10. SCR HOUSE	10.5
11. GENERATOR #1	10.7
12. GENERATOR #2	10.7
13. MUD HOUSE	9.4
14. MUD PUMP #1	10.5
15. MUD PUMP #2	10.5
16. MUD TANK #1	4.4
17. MUD TANK #2	4.4
18. RESERVE PIT	10.0
19. PIPE RACKS (2)	8.7
20. CATWALK	4.4
21. AIR COMPRESSOR	20.0
22. FRAC TANKS (4)	16.0
23. MUD COOLER	24.1
24. CAUSTIC TANK	14.0
25. DEGASSER	20.0
26. PERIMETER FENCE	7.0
27. CYCLONIC MUFFLER	15.0

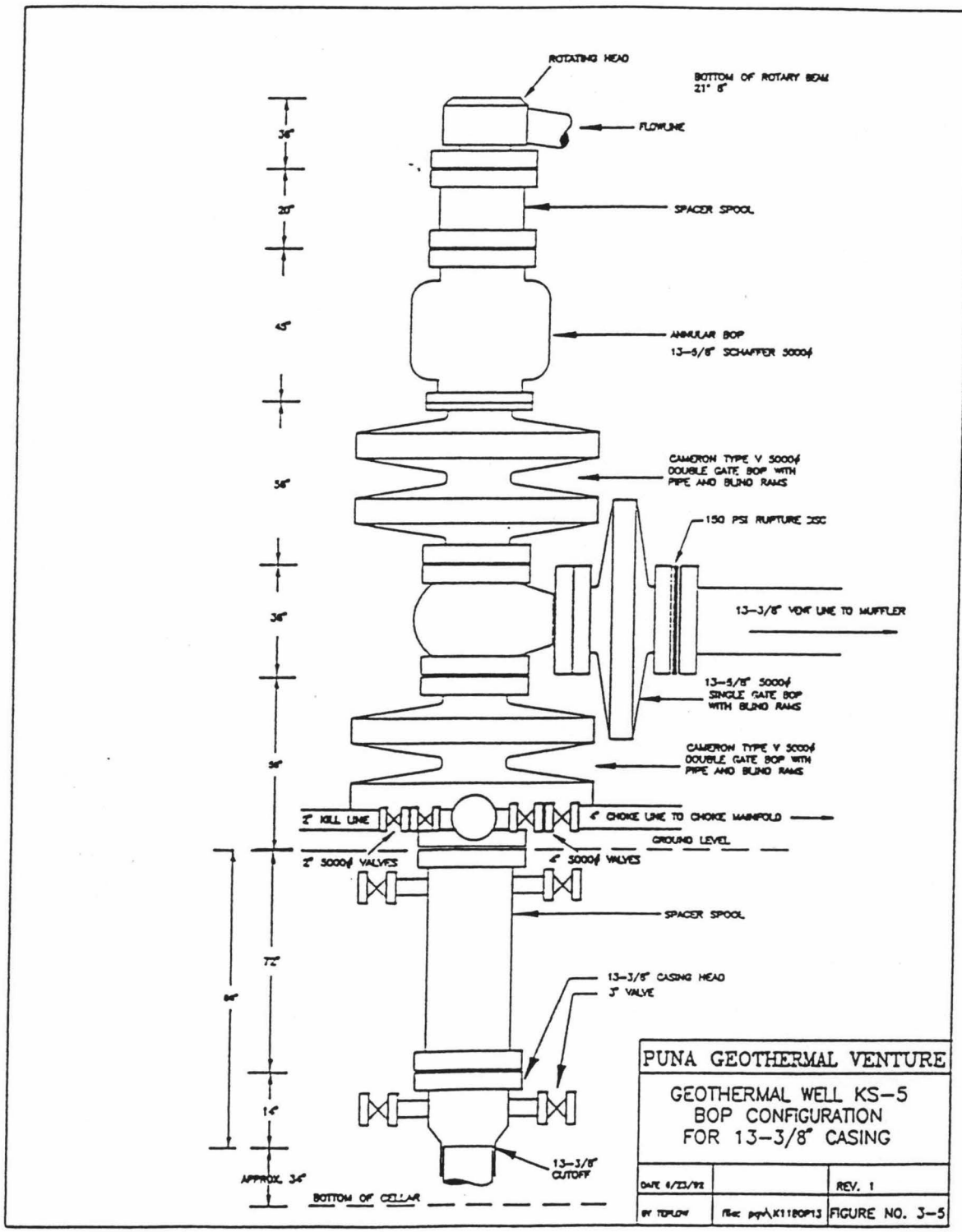
0 50 100 FEET
SCALE

PUNA GEOTHERMAL VENTURE

KS-5 GEOTHERMAL WELL RIG LAYOUT

REV. 6/24/94		FILE: PGV\KS5LAY.DWG
BY W. TEPLOW		FIGURE NO. 3-2

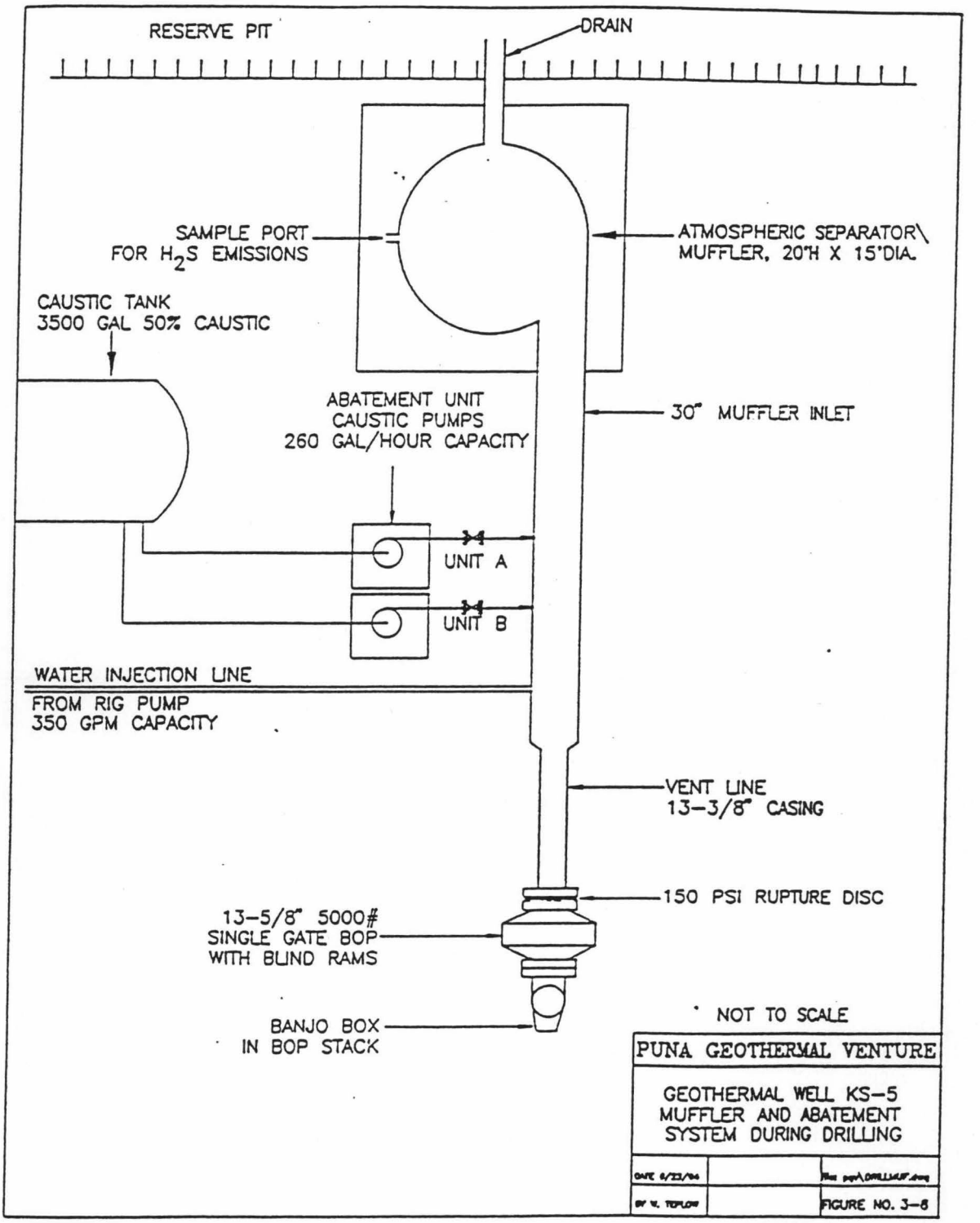

GROUND SURFACE
CELLAR
619' ABOVE MSL
ALL DEPTHS MEASURED FROM KB HEIGHT OF 25' ABOVE TOP OF CELLAR
42" HOLE
30" CONDUCTOR CEMENTED TO SURFACE
70'
26" HOLE
20" 94# K-55 BT&C CEMENTED 0-1000' +/-
CEMENT
1000' +/-
17-1/2" HOLE
13-3/8" 61# K-55 NEW VAM CEMENTED 0-2000' +/-
2000' +/-
9-5/8" 47# C-90 NEW VAM CEMENTED 0-3900'
OPTIONAL 7" LINER FOR INJECTION WELL HUNG FROM WELLHEAD
12-1/4" HOLE
9-5/8" 47# X 7" 29# L-80 LINER HANGER
4000' +/-
OPTIONAL 7" 29# L-80 BT&C SLOTTED LINER HUNG UNCEMENTED 3780'-7400'
8-1/2" HOLE
TD 8500' ±
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL KS-5
CASING DESIGN
DATE 6/28/94
REV. 2
BY TOFLOW
FILE:\PGV\KS5CASE.DWG
FIGURE NO. 3-3

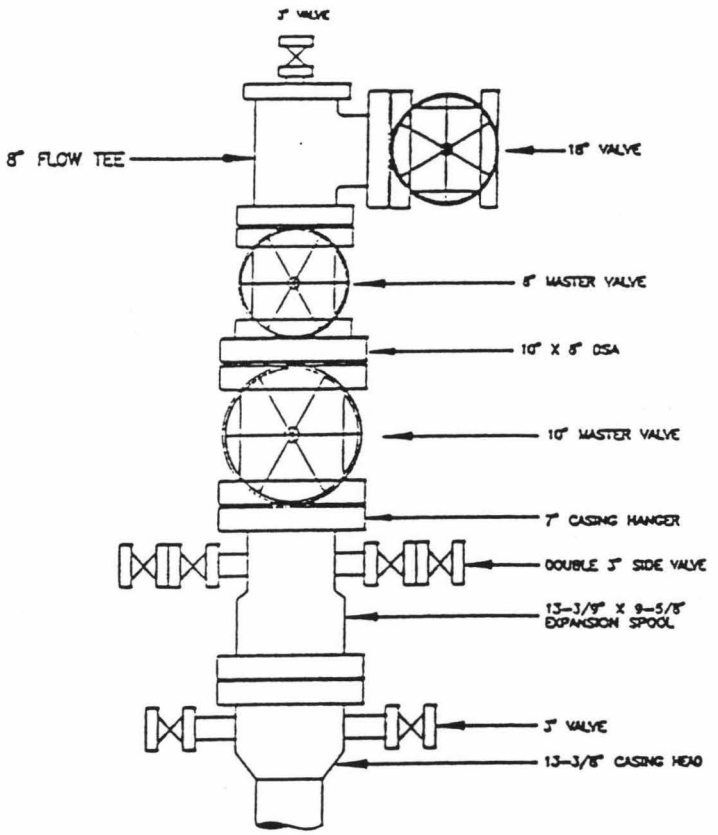


PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL KS-5
BOP CONFIGURATION
FOR 13-3/8" CASING

DATE 4/23/92		REV. 1
BY TOPLOW	file: pgv\K11BOP13	FIGURE NO. 3-5


RESERVE PIT
DRAIN
SAMPLE PORT
FOR H_2S EMISSIONS
ATMOSPHERIC SEPARATOR\
MUFFLER, 20'H X 15'DIA.
CAUSTIC TANK
3500 GAL 50% CAUSTIC
ABATEMENT UNIT
CAUSTIC PUMPS
260 GAL/HOUR CAPACITY
30" MUFFLER INLET
UNIT A
UNIT B
WATER INJECTION LINE
FROM RIG PUMP
350 GPM CAPACITY
VENT LINE
13-3/8" CASING
150 PSI RUPTURE DISC
13-5/8" 5000#
SINGLE GATE BOP
WITH BLIND RAMS
BANJO BOX
IN BOP STACK
NOT TO SCALE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL KS-5
MUFFLER AND ABATEMENT
SYSTEM DURING DRILLING
DATE 6/23/94
BY W. TOFLOW
FIGURE NO. 3-8



PUNA GEOTHERMAL VENTURE

INJECTION WELLHEAD CONFIGURATION FOR KS-5

DATE 6/23/94		REV. 1
BY TEFLON	FILE:PGV_KS11*.DWG	FIGURE NO. 3-7

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT COLOMA-AGARAN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
ERIC T. HIRANO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:LD/WL-EK

MAY 13 2002

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778

Dear Mr. Mizuno:

Modification to KS-5 Drilling Plan

Pursuant to your letter dated April 29, 2002, the request for modification to the drilling plan originally submitted for the drilling permit for Kapoho State No. 5 (KS-5), is hereby granted.

All conditions of the original drilling permit issued on April 10, 2002 shall remain in force in accordance with Chapter 13-183, HAR.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer in Honolulu, at (808) 587-0230.

Sincerely,

GILBERT COLOMA-AGARAN

c: Eric Tanaka

41677

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

April 29, 2002

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Coloma-Agaran:

Enclosed please find a request to modify the KS-5 Drilling Plan. Puna Geothermal Venture (PGV) requests approval of this modification to its existing KS-5 Drill Permit. The essence of this modification is that the KS-5 well casings will be the next size larger than originally permitted. Such increase in size will allow for an increased depth of the well. In addition, PGV will be changing the target to be southeasterly from the wellhead. This will allow the flexibility of using the well for the purposes of production or injection. PGV has been addressing this modification with Mr. Eric Tanaka, Geothermal Compliance Specialist with the Department of Land and Natural Resources (DLNR), so as to comply with DLNR regulations.

June 17th or shortly thereafter is our expected target date to begin drilling KS-5. In developing the necessary plans, information and drawings for the modification, we have attempted to keep Mr. Tanaka well apprised of the changes. DLNR's expeditious approval is greatly appreciated.

Should there be any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representitive

cc: Eric Tanaka-DLNR/Mike Kaleikini/Bill Wiebe

T:\BTM\CORRES.OUT\DLNR\Apps\020429ks-5mod.doc

APPLICATION FOR PERMIT MODIFICATION TO DRILL PROPOSED GEOTHERMAL WELL KAPOHO STATE 5 ON RESERVED LANDS, KAPOHO, PUNA, HAWAII

Complying with Department of Land and Natural Resources (DLNR) Administrative Rule, Title 13, Chapter 183, Section 65, Puna Geothermal Venture (PGV) herewith makes application for a Permit-to-Drill for approval by the Hawaii Board of Land and Natural Resources.

1. **Applicant:**

Puna Geothermal Venture
P.O. Box 30
14-3860 Kapoho Pahoa Road
Pahoa, Hawaii 96778-0030
(808) 965-6233

PUNA GEOTHERMAL VENTURE

By: _____
Barry T. Mizuno
Owner's Representitive
Puna Geothermal Venture

Owner of Mining Rights:

Kapoho Land Partnership

Land Owner:

Kapoho Land and Development Company, Limited

2. **Proposed Well Designation:**

Kapoho State 5 (KS-5) off Wellpad E.

3. A tax key map, designating the approximate location of the drill site for KS-5 off Wellpad E located on State Geothermal Mining Lease R-2; a topographic map, designating the approximate surface elevation at Wellpad E of 619 feet above mean sea level; and a PGV Project map, designating the relative locations of KS-5 and Wellpad E are contained in Attachment I.

4. The proposed PGV geothermal well KS-5 will be directionally drilled to a target area which lies at a horizontal distance of between approximately 400 feet and 2800 feet south easterly of the KS-5 wellhead location, at a depth of between approximately 4000 feet and 8500 feet true vertical depth (TVD), and within the vertical boundary line of the leased property. The well will be drilled for the purpose of providing additional production capacity to fulfill PGV's contractual needs. A secondary target could also be for additional injection capacity for the disposal of PGV's spent geothermal fluid and gases, which is permitted under the Plan-of-Operation approved March 10, 1989, by the Board of Land and Natural Resources

5. A detailed Summary-of-Drilling Procedures is enclosed in Attachment II.

6. A detailed Well Drilling and Completion Program, a drill site Plan, and a Vertical Section of the KS-5 well are contained in Attachment III.

7. A Summary-of-Drilling Reporting Criteria is enclosed in Attachment IV.

8. A description of Lithologic Logging Procedures is enclosed in Attachment V.

9. A multi-well drilling bond ($250,000) has previously been filed with the State of Hawaii.

10. Puna Geothermal Venture agrees to perform such drilling as outlined in this application and agrees to maintain the well in accordance with Title 13, Chapter 183, State of Hawaii, and all Federal and County geothermal regulations.

KS-5 PERMIT MODIFICATION: ATTACHMENT II

PUNA GEOTHERMAL VENTURE
KS-5 DRILLING PROCEDURES
(Except as noted, all depths are referenced to KB.)

Location:
Elevation:
AFE#

1. Move in suitable rig and associated equipment. Rig up all accoutrements prior to spudding.

    1.1. Notify DLNR 24 hours prior to rig up.
    1.2. Install soundproofing.
    1.3. Install direct communications between rig floor, tool pusher and company man.
    1.4. Comply with all sections of the Plan of Operations that pertain to drilling.
    1.5. Instruct drillers to remain on the floor at all times during drilling operations.
    1.6. Adhere to the Drilling Reporting Criteria.
    1.7. Provide DLNR with copies of the tour sheets daily.
    1.8. Conduct pre-spud meeting covering well control, H2S, emergency medical evacuation, safety procedures and well program.
    1.9. Be sure location is secured with proper berms and ditches prior to spud.
    1.10. Weld on 30" conductor pipe and rig up flow line to bubble buster.
    1.11. Conduct Safety Inspections.
    1.12. Fill all mud tanks and storage tanks with water. Minimum total water delivery should be 30+ bbl/minute for possible well control. (See mud program)
    1.13. Rig up H2S monitors and all safety equipment.

2. Drill 26" hole to +/- 700 feet.

    2.1. Make up a 26" stabilized bit on a mud motor with 10" Bottom Hole Assembly (BHA).
    2.2. Strap all tools below the motor.
    2.3. Use water as circulating medium and sweeping hole with calcium carbonate and pre-hydrated gel pills.
    2.4. Catch approximately 10-foot grab samples from drill cuttings and monitor for hydrothermal alteration whenever circulation permits.
    2.5. See attached mud logging (lithologic) procedures.
    2.6. Check returns, if any, for salinity and chlorides.
    2.7. Run maximum reading thermometer (MRT), with surveys, below 500feet.
    2.8. Log temperatures in and out on tour sheets hourly.
    2.9. Continue drilling with water when lost circulation is encountered.
    2.10. Run drilling jars in all assemblies.
    2.11. At +/- 700 feet rig up and bail well until clean water samples are retrieved.
        2.11.1. Notify DLNR 24 hours prior to sampling.
        2.11.2. Collect a representative water sample of ground water at +/- 650 feet.

    2.12. Keep hole straight.

3. Continue drilling 26" hole to +/- 1000 feet. Casing shoe will be set in low permeability rock below major lost circulation zones. The casing will be set if high temperatures or hydrothermal alteration is encountered.

   3.1. Notify PGV Drilling Manager if flow-line temperatures reach or exceed 150 degrees F, or if temperature rise exceeds 10 degrees F/100 feet.
   3.2. Use conventional rotary drilling or mud motors, as appropriate, and water for circulating medium.
   3.3. Use calcium carbonate, loss circulation material (LCM) or high viscosity sweeps to clean well bore as needed.
   3.4. Set and polish off cement plug on bottom if formation is not competent.
   3.5. Continue to monitor for flow or gasses.
   3.6. Conduct BOPE & H2S drills and log on tour sheet.

4. Circulate hole clean and make wiper run with stiff assembly.

   4.1. Circulate hole clean after wiper trip.
   4.2. Measure out of the well bore.
   4.3. Keep hole full, if possible, and check for excess flow.

5. Rig up and run +/- 1000 feet of 22", 0.5", Grade B, Butt Weld casing equipped with float shoe and screw-in float collar with latch down plug. Centralize casing approximately 10 feet above shoe, on the first collar and every third collar thereafter with "Semi-Rigid" centralizers.

   5.1. Run casing at slow speeds to prevent down surge.
   5.2. Fill casing as required to overcome buoyancy.
   5.3. Have casing sized to remain 3-5 feet off of bottom.
   5.4. Be sure casing is centered prior to cementing.

6. Run in hole with drill pipe and screw into 22" float collar.

   6.1. Circulate hole clean. Reciprocate casing 5-10 feet while circulating to prevent differential sticking if well bore remains full.

7. Cement casing as per cementing program.

   NOTE: If pressure drops off during cement job, pump tail slurry, drop and displace latch down plug and rig up for top job.

   7.1. Monitor returns and surface pressures throughout job.
   7.2. Center casing and wait on cement (WOC).
   7.3. Be prepared to do a top job with High Early (accelerated) Redi Mix. Order out at least 30 yards Redi Mix. Add 50% silica flour to the last load.
   7.4. Have at least 20 cubic yards of sand, gravel and/or volcanic cinders on hand to fill annulus through lost circulation zones if required.
   7.5. WOC a minimum of 12 hours on initial cement job before drilling.

8. Cut off casing and weld on 20" 2000# casing flange.

   8.1. Install pre-fabricated 20" 2000# slip on flange.

8.2. Install prefabricated 22" riser with 20" 2000# flanges and 2 each 6" side outlets with 6" valves and 6" rupture disks or air actuated rubber bladder for diverter lines.

9. Install 20" 2000# annular preventor and rotating head.

9.1. Notify DLNR 24 hours prior to testing.
9.2. Test BOPE and casing and have DLNR witness and approve test.
9.3. Log test results on tour sheet and morning report. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
9.4. Periodic BOPE drills will be conducted and logged on tour sheets.
9.5. Install and test high efficiency mud cooler. Run coolers, if and as needed.
9.6. All personnel will have BOPE training. Training will be logged on the daily tour report.

10. Make up 20" bit on slick assembly. Clean out cement with mud.

10.1. See mud program.

11. Drill 1-5 feet of new 20" hole and circulate clean with mud.

12. Perform leak-off test with 6" valves closed and squeeze if necessary.

13. Install 6" diverter lines. Install H2S abatement equipment on deviator lines.

14. Make up BHA and drill 20" hole to +/- 2200 feet.

14.1. Keep hole straight.
14.2. Survey at approximately 90-foot intervals and run MRT.
14.3. Catch 10-foot grab samples, clean, dry, bag in envelopes and label two complete sets of samples.
14.4. Check mud for increased salinity and chlorides.
14.5. Monitor well for increase or decrease in flow rates and gasses.
14.6. Keep close watch on samples for changes in mineralogy indicative of a high temperature geothermal reservoir.
14.7. Be prepared to set casing if there are any signs of encountering a high temperature reservoir.
14.8. Cement off all lost circulation zones.

15. Run high pump volumes to properly clean hole. See hydraulics program.

15.1. Run all solids control equipment. Use course shale shaker screen if necessary to handle volume. This will be a closed loop system.
15.2. Keep a close eye on the sumpless system, do not let the cuttings tank overflow. Run mud cleaner at all times.
15.3. Keep plastic viscosity and gel strengths as low as possible with at least a 1/32" mud cake and a water loss of 10. (See attached Mud Program)

16. Circulate hole clean and make wiper trip to shoe.

16.1. Measure out of the well bore. Keep hole full at all times.

16.2. Monitor well and be sure well takes proper amount of fluid.
16.3. Check and log any fill on bottom.
16.4. Circulate hole clean and pump sweep.

17. Pull out of the well bore keeping hole full.

18. Rig up and run 16", 97#, L-80, BOSS thread casing equipped with float shoe, float collar one joint above shoe and extended casing packer (ECP)/Port collar just below 22" casing shoe. Centralize approximately 10 feet above shoe, on first, second third and every third collar thereafter with "Double Bowed" centralizers. Do not use centralizers inside of 22" casing.

18.1. Use thread protectors.
18.2. Run casing at slow speeds to prevent down surge.
18.3. Fill casing with mud while running.
18.4. Continue monitoring the well. Keep hole full.
18.5. Have casing sized to remain off of bottom and to keep collar out of cut off area.

19. Circulate and condition hole for cement. Cement casing using two stages. Do not circulate anything but cement after opening port collar. Do not displace excess cement in annulus with anything but more cement, keep all water and fluids out of annulus.

20. Cement casing as per cementing program.

20.1. Monitor returns and pressures throughout job.
20.2. Inflate ECP with cement after bumping plug as per cementing program.

21. WOC at least 12 hours.

22. Cut off casing and install 16" 5000 casing head, using "Hot-Hed" system for stress release. Test weld to approximately 2500 psi with nitrogen.

23. Install 16" 5000# mud cross, 16" 5000# double gate, 16" 5000# Banjo Box or Flow Tee or equivalent with rupture disk and remote-operated valve to blooie line. Install 16" 5000# double gate, 16" 5000# annular preventor, rotating head , choke and kill lines, blooie line and muffler. Also, connect water and abatement lines to the blooie line, as shown in the BOPE attachments. Install and check all monitoring equipment. WOC 16 hours prior to testing.

24. Be sure all monitoring equipment is in place including well head pressure gauge.

25. Notify DLNR 24 hours prior to BOPE test.

25.1. Log all test results and approvals on tour sheet and morning report.
25.2. All pushers, drillers and derrick men will be trained in the use of monitoring equipment. Training will be logged on the tour sheets.
25.3. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
25.4. Install test plug and test BOPE to approximately 2500 psi below top double gate.

26. Make up 14-¾" bit on a slick BHA to clean out cement and floats.

26.1. Drill 3-5 feet of new hole and circulate clean with mud.
26.2. Perform leak-off test with mud and squeeze if necessary.

27. Drill 14-¾" hole to +/- 5000 feet. Casing point will be in the cap rock above the reservoir as determined by the well site geologist using the criteria described in the "Plan of Operations".

27.1. Run profile nipples in all drilling assemblies.
27.2. Raise the mud weight while drilling to 10.8#/gallon. Below approximately 3200 feet, maintain approximately 2100 psi hydrostatic pressure at the bit or sufficient hydrostatic to prevent flow if required.
27.3. Perform directional drilling in the 14 ¾" hole section. Survey as required with intervals not to exceed approximately 120 feet'. Run MRT with all surveys. See directional program.
27.4. Catch 10-foot grab samples of drill cuttings.
27.5. Keep close watch on all mud properties. Keep pH concentration at about 9. See mud program.
27.6. Monitor well for increase or decrease in flow rates and gasses.
27.7. Keep close watch on samples for changes in mineralogy indicative of a high temperature geothermal reservoir.
27.8. Be prepared to set casing if there are any signs of encountering a high temperature reservoir.
27.9. Observe drill pipe pressure prior to connections. If there is pressure on drill pipe with pump off and no flow at flow line, even with a float in the string, then a steam bubble may be forming in the drill string.
27.10. Cement off all lost circulation zones. If necessary, reduce mud weight.
27.11. Turn on one mud cooler when flow line temperature reaches 150 degrees F. Turn on second mud cooler when flow line temperature again reaches 150 degrees F.
27.12. If well indicates flow or pressure during trips, cool hole with both coolers on and then recheck well for flow.

28. Circulate hole clean and wipe hole to shoe. Strap out.

29. Rig up and run 11-¾", 65#, C-90, SLHC thread casing equipped with Float Shoe, Float Collar 80 feet above shoe, ECP and port collar just inside of 16" casing.

29.1. Use thread protectors. Run casing at slow speed to prevent down surge but fast enough to arrive at bottom prior to major heat build up. Fill casing with mud while running to overcome buoyancy.
29.2. Keep monitoring well. Keep hole full at all times and have casing sized prior to running.
29.3. Centralize casing as follows: approximately 10 feet above shoe, 1st, 2nd, 3rd, and every 4th collar to the 16" shoe. Use positive centralizers inside of the 16" casing, on 1st collar above the ECP and every 3rd collar to the first collar below ground level.
29.4. Size casing so no collar will be in the expansion spool pack off area.
29.5. Centralize casing with casing rams in the lower BOPE and casing head brass set screws.

30. Circulate and condition hole for cement job, monitor flow line temperature and be sure the temperature has dropped off prior to cement job. Conduct cement procedure review

with all participants prior to cementing. Cement casing using two stages with NO water between stages. See attached Cement Program and cement accordingly.

31. WOC a minimum of 16 hours.

32. Cut off casing and install expansion spool as directed by Expansion Spool representative.

    32.1. Use hydraulic torque wrench on all studs attached to the expansion spool (including those on wing valves).
    32.2. Use Power Plant (Power Piping Code) pattern and tighten all studs to maximum specifications.
    32.3. 32.3 Seal weld centering ring hold-down studs to eliminate any chance of leakage, after tightening.
    32.4 Test to approximately 3500 psi with nitrogen.

33. Install 12" 1500 Series Master Valve and BOPE (See attached BOPE figure).

    33.1. Use power plant (Power Plant Piping Code) pattern and tighten all studs to maximum specifications when installing Master Valve.
    33.2. Notify DLNR 24 hours prior to testing BOPE.
    33.3. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
    33.4. Install test plug and test BOPE to approximately 3500 psi below top double gate.
    33.5. Test BOPE above top double gate to approximately 2500 psi and annular preventor to approximately 2000 psi.
    33.6. Test to be witnessed and approved by DLNR. Log all test results and approvals on tour sheet and morning report.

34. Clean out casing and drill 1-5 feet of new hole below shoe.

    34.1. Circulate hole clean and cool.
    34.2. Perform leak-off test and squeeze if required. Pressure gradient will be provided by Drilling Manager.

35. Drill 10-5/8 " hole to +/- 8000 feet TVD or until sufficient production is encountered.

    NOTE: 8-5/8", 36#, L-80, SLHC thread casing may be run and cemented with Double lip Liner Hanger if 11-3/4" casing is deemed too shallow or formation is unstable. (See supplemental program – following pages.)

36. Continue drilling 10-5/8" hole or (7-7/8" hole if 8-5/8" casing has been set) to TD.

    36.1. Use mud weight that provides approximately2150 psi hydrostatic head pressure at the casing shoe and maintain mud weight sufficient to provide approximately 2150 hydrostatic while drilling.
    36.2. Take surveys every 120 feet and include MRT.
    36.3. Catch 10-foot grab samples of drill cuttings.
    36.4. Keep close watch on mud properties. Weight up as needed to control well. Keep pH at approximately 9.
    36.5. Be sure all monitoring equipment is in good working order.
    36.6. Watch closely for flow or loss and for changes in mineralogy indicative of high temperature geothermal reservoir.

36.7. Run both mud coolers.
36.8. If well indicates flow or shut in pressure during trips, cool hole with circulation and recheck hole parameters.
36.9. Stroke Master Valve from full open to close and function test BOPE on every trip.

37. T.D. will be Kelly down after total loss circulation occurs or one connection below which is approximately 90feet with Top Drive connections.

37.1. Place well on kill line at 5-7 barrels per minute and strip out of the well bore to shoe.
37.2. Monitor well while stripping out and maintain vacuum.
37.3. Notify Drilling Supervisor and Drilling Manager immediately.

38. Upon reaching shoe, be sure well is shut in.

38.1. Displace drill string with soapy water.
38.2. Build mud volume to full capacity with proper kill weight mud.
38.3. Kill well with mud and place well on kill line at 5-7 barrels per minute.
38.4. Strip out of the hole and monitor well head pressure closely. Maintain well on vacuum of at least –1 (negative one) psi well head pressure.
38.5. Close blind and start pumping water at 8-10 barrels per minute for at least 5 hole volumes. Monitor well head pressure (WHP).
38.6. Close Master Valve. Monitor WHP.

39. Lay down drill pipe and tools in mouse hole. Tighten all flanges on well head equipment and valves.

40. Tear out BOPE and install second 12" 5000# Master Valve. Install companion flange and swab valve.

41. Install Barton recorder and dial gauge to monitor well pressure.

42. Secure well, rig down and move rig out.

43. Release well to O&M. Note release time on tour sheets.

44. Submit well completion records including: Well record sheet, bit record casing details, pipe measurement records, well schematic diagram, well head assembly diagram and serial numbers of well head valves to Puna Geothermal Office within one week.

Supplemental Program for 8-5/8" Casing

NOTE: If 11-3/4" casing was set earlier than approximately 5000 feet due to hydrothermal alteration or formation was deemed to be unstable, then proceed with the following supplement.

1. Drill 10-5/8" hole from shoe of 11-3/4" casing to +/- 5000 feet following guidelines found in Step 36.

2. Circulate the well clean. Pull out of the well bore to the shoe of the 11-¾" casing and run back to bottom.

2.1. Circulate the hole clean and cool.
2.2. Measure drill string while pulling out of the well bore.

3. Rig up and run 8-5/8", 36#, L-80 SLHC thread casing, equipped with Float shoe and Float collar placed approximately 80 feet above shoe, and Double Slip liner hanger made up on top joint prior to running casing. Casing will be stabilized with Semi Rigid centralizers placed 10 feet above shoe, 1st, 2nd, 3rd and every other collar thereafter.

3.1. Maintain an approximately 200-foot lap inside of the 11-¾" casing.
3.2. Use thread protectors and run casing at slow speeds.

4. Tag bottom for redundancy of pipe tally. Circulate to clean and cool well bore.

4.1. Be sure temperature has dropped at flow line prior to cementing.
4.2. Reciprocate liner while circulating.

5. Hang 8-5/8" liner 10 feet from bottom and break nut on liner hanger.

5.1. Cement casing as per attached Cement Program.
5.2. Unscrew from liner hanger and pull out of hole (POOH).
5.3. Do not circulate cement out of the hole above liner hanger.
5.4. WOC

6. Make up 10-5/8" bit on slick assembly and run in hole (RIH). Clean out cement to the top of the Liner Hanger

6.1. Circulate hole clean and POOH.

7. Make up 7-7/8" bit and clean out Chevron Packing and cement to top of the float collar.

7.1. Circulate hole clean.
7.2. Notify DLNR of casing integrity test 24 hours in advance.
7.3. Pressure test liner lap to 0.9 gradient or as specified by Drilling Manager.
7.4. Squeeze lap if necessary.

8. Test casing and BOPE and record on tour sheet along with DLNR approval.

9. Drill out cement, Float Collar and Shoe.

10. Drill 7-7/8" hole to TD following the procedures laid out in Step 36 of the Drilling Program.

KS-5 PERMIT MODIFICATION: ATTACHMENT III
PUNA GEOTHERMAL VENTURE
DEVELOPMENT WELL DRILLING PLAN
FOR WELL KS-5

CONDUCTOR CASING AND CELLAR:

A thirty-inch (30") conductor pipe will be set in a 42" hole that was drilled to a depth of 70 feet below ground level. The conductor is to be cemented in place with concrete placed down the backside of the 30" conductor pipe.

If a cellar is not already in place, then, following the setting of the conductor pipe, dig an earthen cellar and construct a reinforced concrete cellar according to civil contractor's design and specifications (Figure 3-1).

DRILLING - 26" HOLE:

Rig up a suitable drilling rig as shown in Figure 3-2. Weld on 30" pitcher nipple. Spud in with 26" bit. Anticipate losing total returns at any time below surface. Continue drilling ahead on water, aerated mud or foam without returns. Run maximum reading thermometer (MRT) during directional surveys every 90 feet below a depth of approximately 500 feet. Drill to a depth of 700 feet.

At this depth rig up bailer and bail continuously or as required to get a representative ground water sample. Collect samples and send to lab for analysis. Have DLNR witness sampling procedure. Notify DLNR 24 hours prior to taking samples.

Resume drilling 26" hole on water, aerated mud, or foam. Drill to a depth of approximately 1000 feet, the casing point for 22" casing. If abnormal temperatures are encountered, then notify the drilling superintendent and stop drilling. The 22" casing may be set at that point after consulting with and receiving permission from Department of Land and Natural Resources (DLNR).

SURFACE CASING:

Approximately 1000 feet of 22", 0.5" wall, Grade B, butt weld thread casing will be run and cemented in place (Figure 3-3). Run casing while filling on every second joint.

Cement 22" casing through drill pipe with Hawaii cement + 40% silica flour.

Wait on cement for 12 hours. Have at least 200 cubic yards of sand, gravel, and/or volcanic cinders on hand.

Pick up and run 1" tubing down backside of 22" casing. Tag fill. Mix and pump Hawaii cement + 40% silica flour. Circulate to surface. Pull tubing and wash while laying it down. Wait on cement for 12 hours. Should the cement settle, top out with batched ready-mix poured down the backside of the 22" casing. Ready-mix can be accelerated with 2% by weight of calcium chloride. Wait on cement for 12 hours.

BLOWOUT PREVENTION EQUIPMENT (20-inch BOPE) 22" HOLE (Figure 3-4):

Cut off casing and weld on 20" 2000# casing flange and 2 side outlets. Valve the outlets with 3" gate valves.

Blowout prevention equipment to drill a 20" hole shall consist of a 20" 2000# annular preventer and diverter system as shown in Figure 3-4. Test BOPE, per DLNR requirements, and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing.

DRILLING 20" HOLE:

Drill out from underneath the 22" surface casing with mud. Make up a 20" mill tooth bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent of approximately 10#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Drill out and trip for bottom hole assembly.

Should lost circulation persist, loss interval(s) should be cemented.

The 20" hole is to be drilled to a depth of approximately 2000 feet where 16" casing is to be run.

INTERMEDIATE CASING:

Approximately 2000 feet of 16", 97#, L-80, BOSS thread casing is to be run and cemented in place in a single stage (Figure 3-3).

Cement with Hawaii cement + 40% silica flour. If losses are encountered below the 22" casing shoe, then it may be advisable to cement the 16" string with a light weight cement slurry tailed by 200 sacks of tail slurry. Pump 60% excess.

BLOWOUT PREVENTION EQUIPMENT (16" BOPE) 14-3/4" HOLE (Figure 3-5):

Cut off casing and install 16", 5000# casing head. Blowout prevention equipment to drill a 14-3/4" hole will consist of a mud cross, two 16" 5000# double gate preventers, a 16" 5000# annular preventer, a banjo box/flow tee/equivalent with rupture disk and single gate preventer on the side outlet with blind ram inserts, a rotating drilling head, choke, and kill line (Figure 3-5). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment on blooie line (Figure 3-8).

DRILLING 14-3/4" HOLE:

Drill out the shoe with a 14-3/4" bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent to 11#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Squeeze if required. Trip for bottom hole assembly. Drill to casing point at approximately 5000 feet.

PRODUCTION CASING:

Approximately 5000 feet of 11-3/4" 65#, C-90, SLHC thread casing is to be run and cemented (Figure 3-3). Cement casing with Hawaii cement + 40% silica flour. After WOC, cut off the 11-3/4" casing. Nipple up 16" 5000# x 12" 1500 Series expansion spool with packing sleeve.

BLOWOUT PREVENTION EQUIPMENT (13-5/8" BOPE) 10-5/8" HOLE (Figure 3-6):

Blowout prevention equipment to drill the 10-5/8" section of hole should consist of a 12" 5000# gate valve, 12" 5000# x 13-5/8" 5000# double-stud adapter (DSA), two 13-5/8" 5000# double gate preventers, a 13-5/8" 5000# annular preventer, a banjo box/flow tee/equivalent with a rupture disk and a single-gate preventer on the side outlet, a rotating drilling head, choke, and kill line (Figure 3-6). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment and muffler on blooie line and choke line. Provisions will be made to abate any well flow from the choke line or the blooie line.

DRILLING 10-5/8" HOLE:

Drill out from underneath the 11-3/4" casing on water with a 10-5/8" bit and slick bottom hole assembly. Perform leak-off test and note test results on IADC tower report. Squeeze if required. Notify appropriate State agencies 24 hours prior to testing. Trip for packed BHA and continue drilling ahead on mud.

Should differential sticking occur, rig up the air compressor and circulate with air to free the stuck string.

At total depth (TD) circulate out mud with fresh water. Trip-out of hole and rig up flow test. If test is successful, then run perforated liner, if required to keep the hole open.

PRODUCTION LINER (Primary and Alternate Drilling Target):

Production liner will be run only if it is needed to keep hole open. Trip in hole with slick BHA and check for fill. If hole is open, then run approximately 3000 feet of 8-5/8", 36#, L-80, Buttress Thread and Coupling (BTC) casing perforated with round holes. Run liner with cement guide shoe on bottom and hang on a single slip cone type liner hanger (Figure 3-3). Release from hanger and trip out laying down.

Nipple down BOPE and install final wellhead for production well, as shown in Figure 3-7.

KS-5 PERMIT MODIFICATION: ATTACHMENT IV
PUNA GEOTHERMAL VENTURE
DRILLING REPORTING CRITERIA

1. The Drilling Supervisor shall report to the PGV Drilling Engineer or his designated relief on the day-to-day operations.

2. As closely as possible, the Drilling Supervisor will follow the drilling program for a particular well as provided by the Drilling Engineer. There will be changes in the drilling program as the well progresses, and these changes must be discussed with the Drilling Engineer before action is taken.

3. Approximate casing setting depth will be set in the Drilling Program with assistance from the Geologist. These depths should be used absent other information A mud program will be outlined in the Drilling Program, and this program should be followed as closely as possible. The Drilling Supervisor shall have ample latitude to change the mud program as dictated by the actual drilling conditions.

4. Historical drilling data have been developed regarding the Puna Geothermal Project, and this data should be used to the best advantage in drilling wells within the project.

5. In and out mud temperatures and maximum recording temperatures will be logged on the IADC tower report.

6. When drilling below the 16" casing shoe, special precautions must be taken when encountering any lost circulation zones or drilling breaks.

7. If a drilling break is encountered while drilling, then the pipe should be picked up to properly place tool joint and bottoms up should be circulated around. The PGV Drilling Supervisor should be immediately notified along with the contractor's supervisor. A temperature survey should be run whenever a drilling break is encountered. An interpretation of the survey should be made by the Drilling Engineer before drilling further. It is important not to drill ahead with excessive temperature in the mud returns.

8. The driller should also note in the IADC tower report any gains or losses in the mud pit volume. Any significant mud loss should be reported to the PGV supervisor(s) and the Contractor's supervisor(s). If any continuous or significant mud gain is encountered, then the driller should pick up the pipe and check for flow and notify the supervisors. If flow is observed, then the well will be shut in immediately.

9. Based on past experience at the Puna Geothermal Project, it is imperative that constant supervision of the well be accomplished once drilling is undertaken below the 16"casing shoe.

10. PGV Supervisors will be in charge of all activities on location. PGV Supervisors will report to the PGV Drilling Engineer or Drilling Manager.

11. Drilling Supervisors will spend sufficient time together at the rig during change-out to exchange information on the current activities. Drilling Supervisors will be on the floor, on the pump truck, in the wireline unit, etc. for all critical operations.

12. The Drilling Engineer will be responsible for engineering programs with input from the Drilling Supervisors. The Drilling Engineer will also advise and assist the Drilling Managers and Supervisors.

13. Contractor's supervisors will report to the Drilling Supervisor on location. They will also be on the floor during all crew changes.

14. Reporting procedures for crews will be the responsibility of the drilling contractor. Drillers will log all rig operations on the IADC daily tower report, including the depths of all work performed. Rig crew will assist service company personnel as directed by the contractor's supervisor.

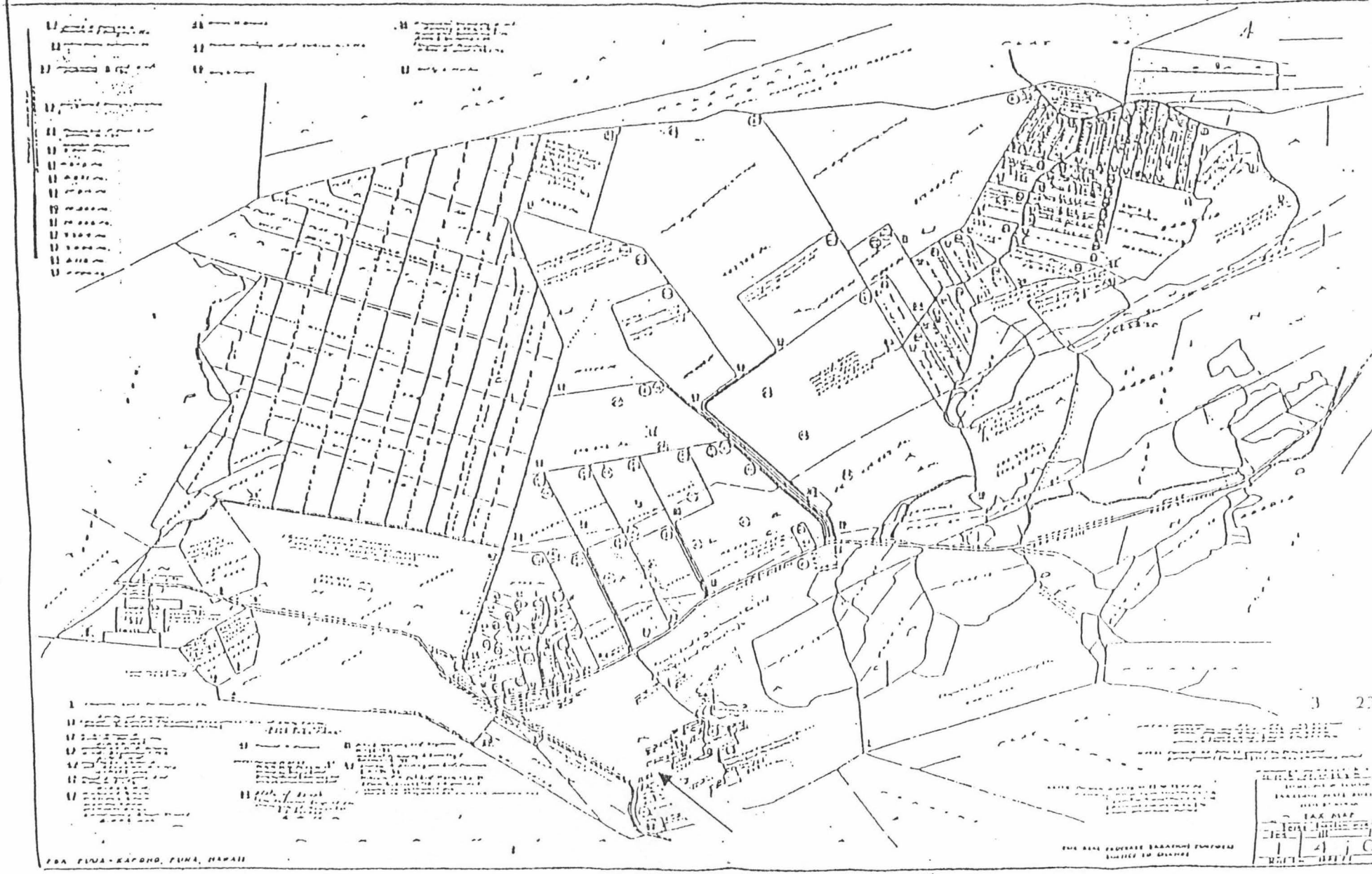
KS-5 PERMIT MODIFICATION: ATTACHMENT V
PUNA GEOTHERMAL VENTURE
PROCEDURES FOR LITHOLOGIC ("MUD") LOGGING

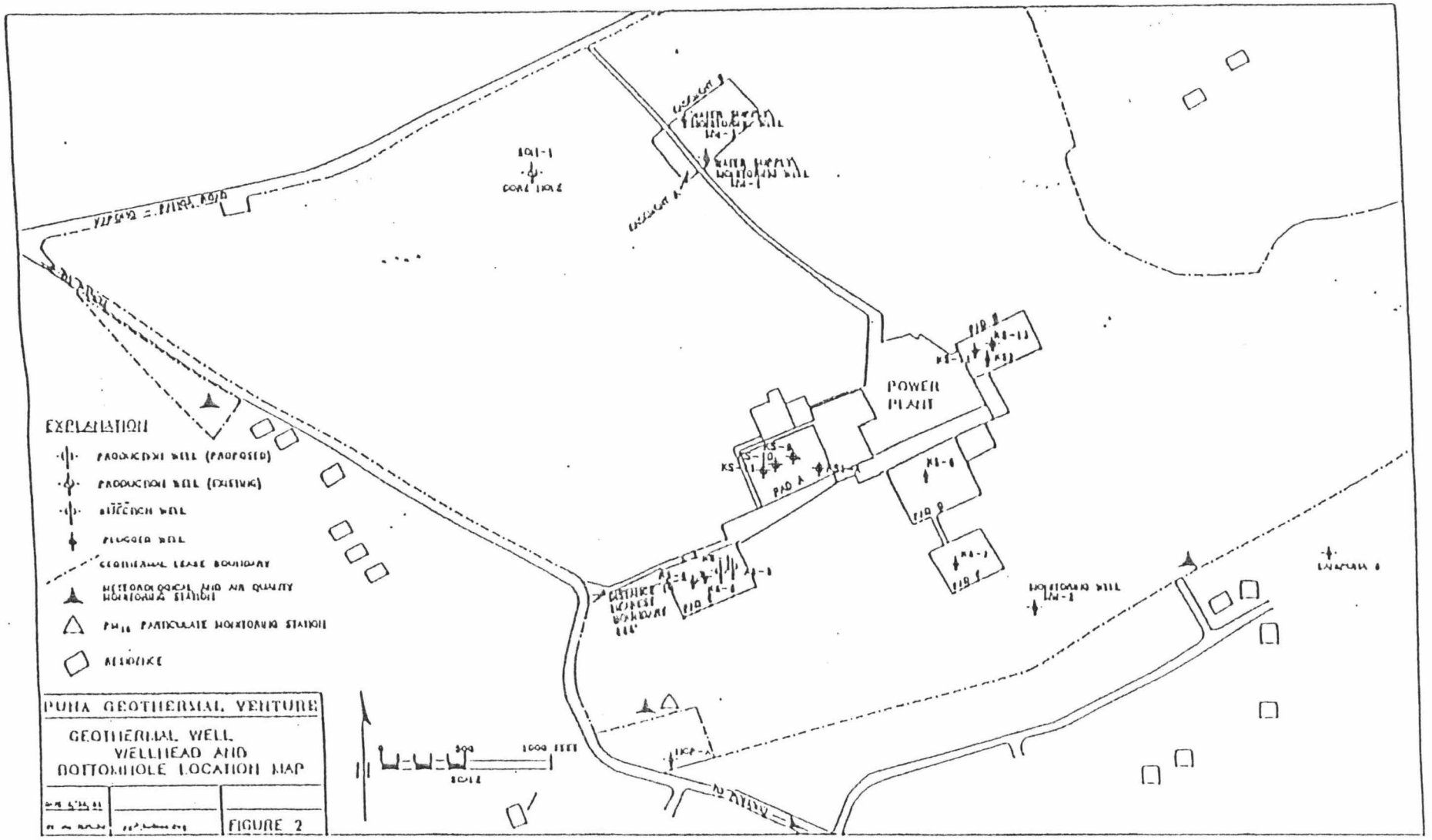
While drilling, depths are recorded on a Bristol chart (a circular chart matching time versus depth). As a single joint is drilled, each ten-foot interval (i.e., 100, 110, 120, etc.) is marked and labeled on the chart. A lag time (the interval of time, measured in minutes, required to circulate drilling fluids from the bit to the surface) is calculated based on hole size and pump rates and a marker is set to indicate when a marked depth reaches the surface.

When drilling fluids containing suspended drill cuttings derived from a given interval reach the surface, such fluids travel down the flow line and over the mesh shaker screens. After the latest ten-foot interval has accumulated at the base of the shakers, the mud logger obtains a representative sample of the drill cuttings. The sample is then washed of the drilling fluid. One portion of the cuttings, the wet sample, is placed in a plastic bag and the remainder is dried and bagged in sample sets.

A small amount is retained to view under a stereomicroscope. The cuttings from each ten-foot interval are then visually and physically evaluated. Detailed written descriptions of each ten-foot interval are entered on work sheets which are subsequently summarized onto the mud log data sheet. The lithologic descriptions include rock type, color, texture, hardness, structural characteristics, alteration (if any) and secondary mineralization.

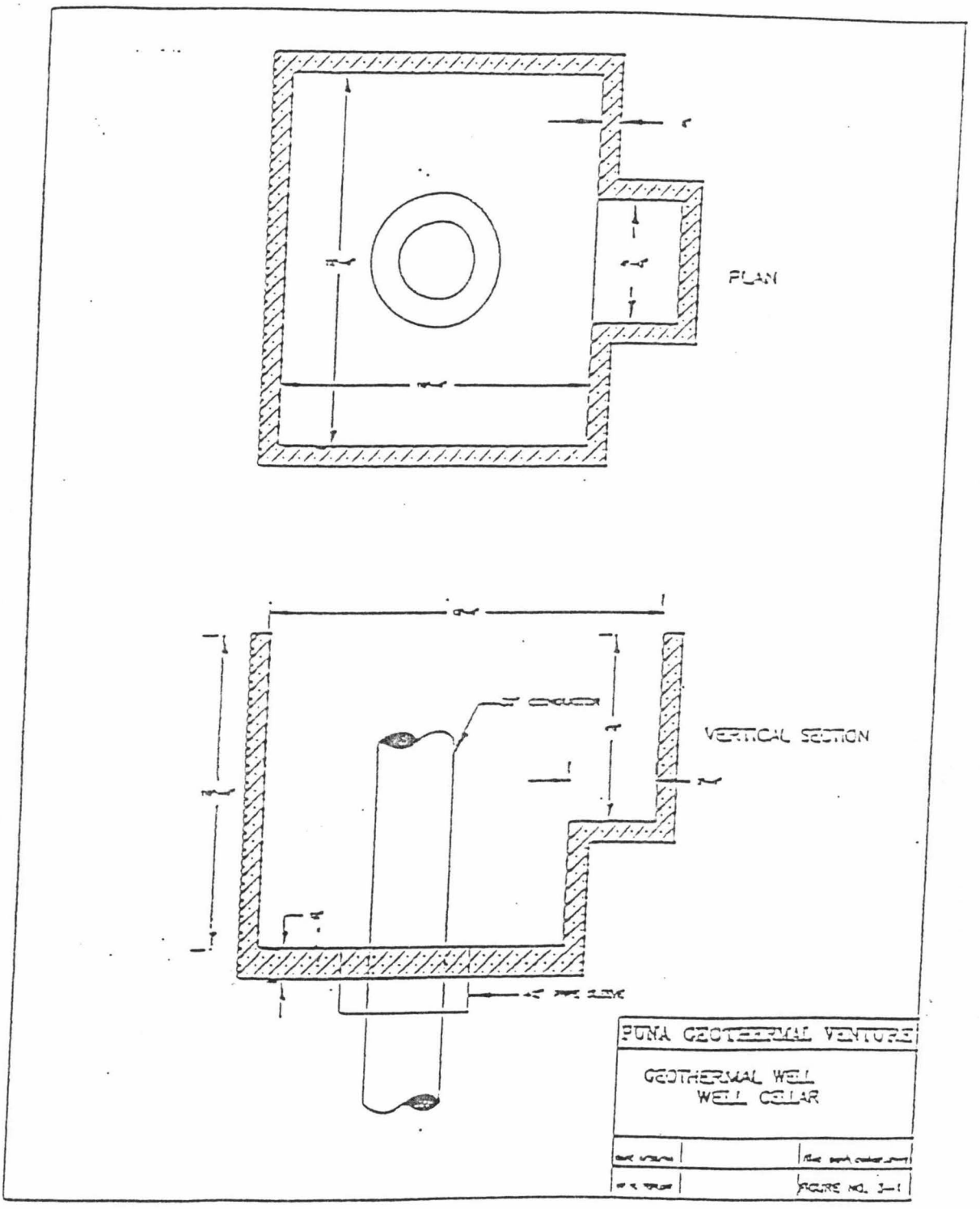
FIGURE 1

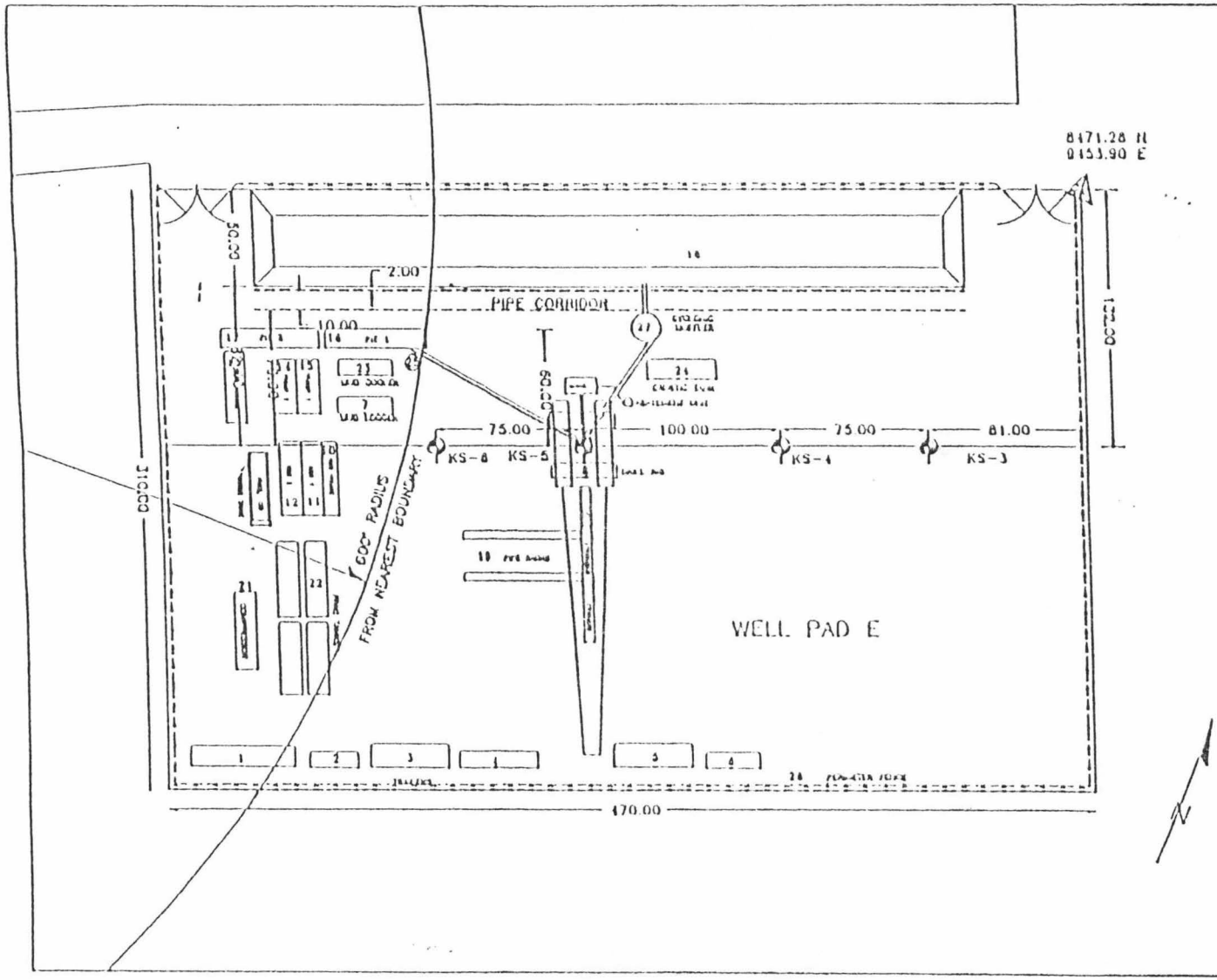



POWER PLANT
EXPLANATION
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL WELLHEAD AND BOTTOMHOLE LOCATION MAP
FIGURE 2

Puulena Crater
Puulena Crater
Observatory
Observatory
M I L M

FIGURE 3


PLAN
VERTICAL SECTION
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL
WELL CELLAR
FIGURE NO. 3-1



EQUIPMENT LIST

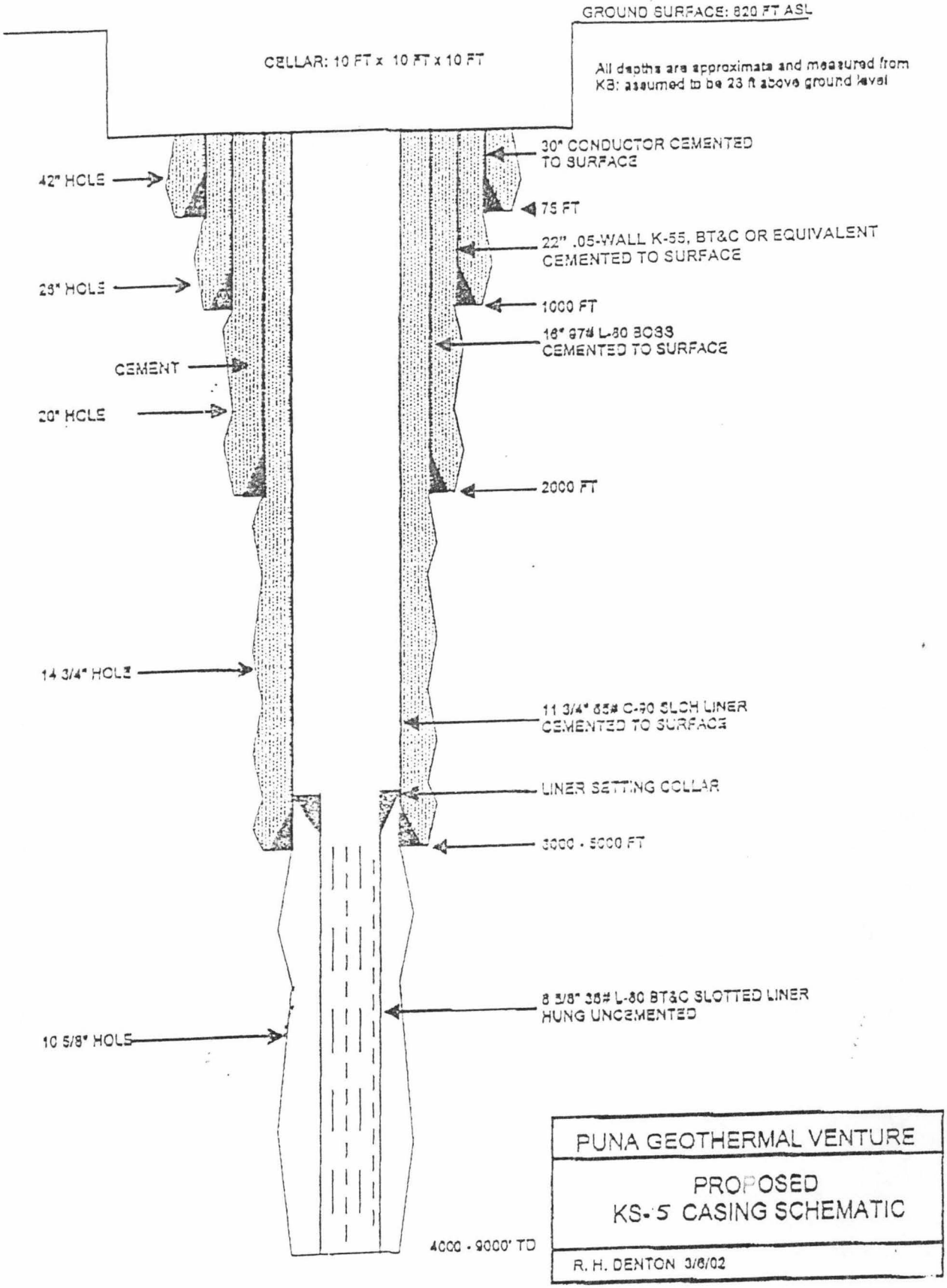
ITEM	HEIGHT (FT)
1. GEOLOGIST TRAILER	14.0
2. DIRECTIONAL SERVICES	12.0
3. AIR SERVICES	12.0
4. TOOL PUSHER	12.0
5. DRILLING SUPERINTENDENT	14.0
6. MUD SERVICES	12.0
7. MUD LOGGER	12.0
8. DRILL RIG	148.0
9. WATER TANK/FUEL TANK	20.0
10. SCR HOUSE	10.5
11. GENERATOR #1	10.7
12. GENERATOR #2	10.7
13. MUD HOUSE	8.4
14. MUD PUMP #1	10.5
15. MUD PUMP #2	10.5
16. MUD TANK #1	4.4
17. MUD TANK #2	4.4
18. RESERVE PIT	10.0
19. PIPE RACKS (2)	4.7
20. CATWALK	4.4
21. AIR COMPRESSOR	20.0
22. FRAC TANKS (4)	14.0
23. MUD COOLER	24.1
24. CAUSTIC TANK	14.0
25. DEGASSER	20.0
26. PERIMETER FENCE	7.0
27. CYCLONIC MUFFLER	15.0

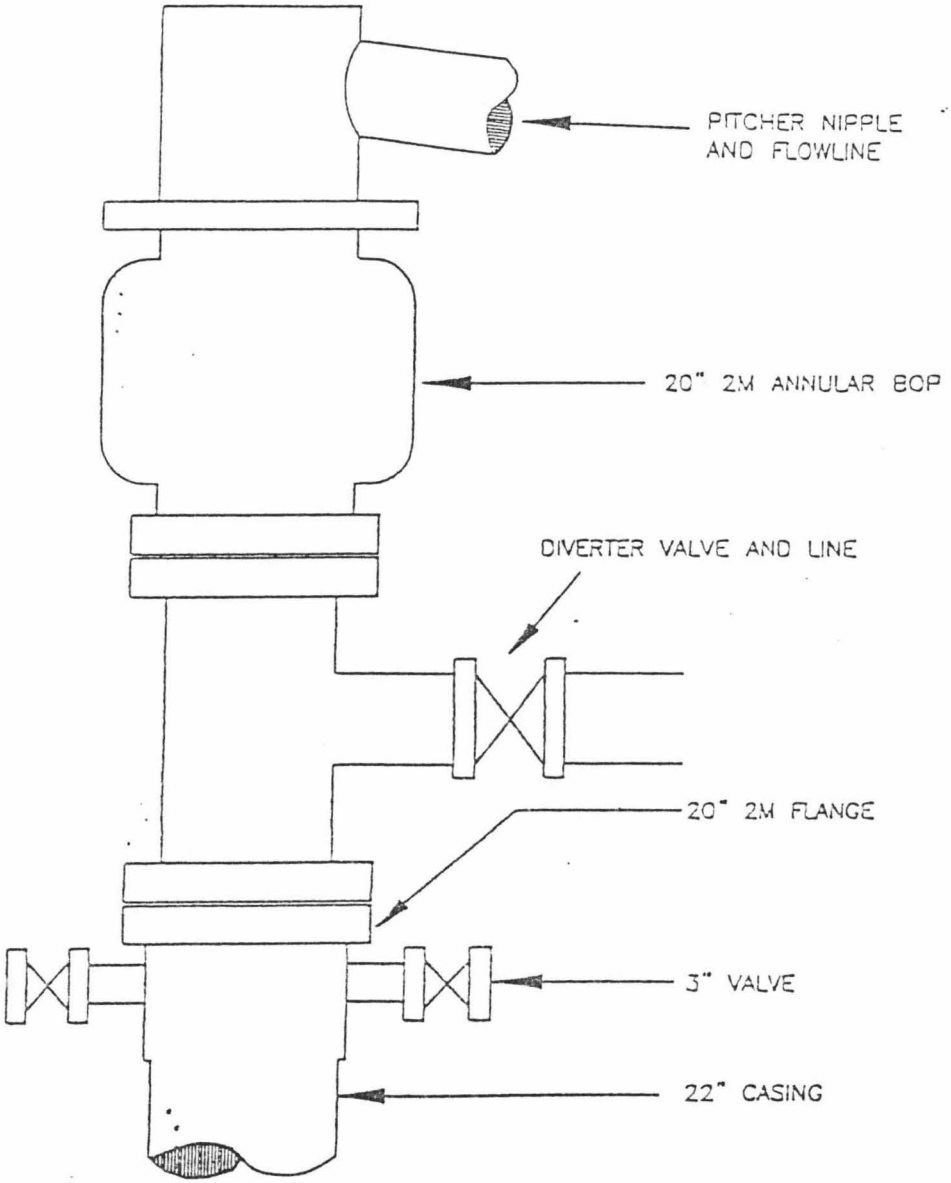
50 100 FEET
SCALE

PUNA GEOTHERMAL VENTURE

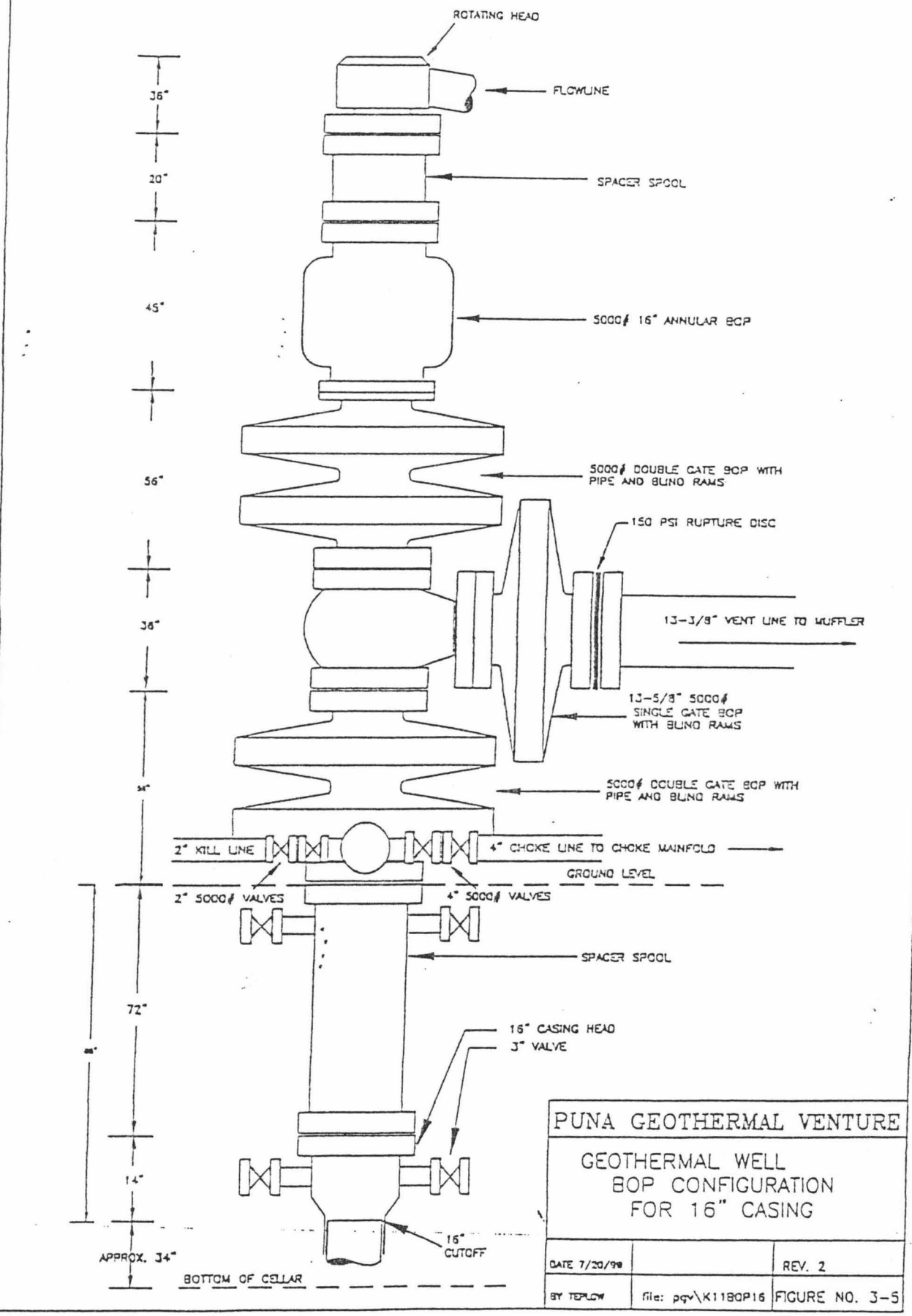
KS-5 GEOTHERMAL WELL RIG LAYOUT

REV. 8/24/94		
BY M. TAYLOR		FIGURE NO. 3-2

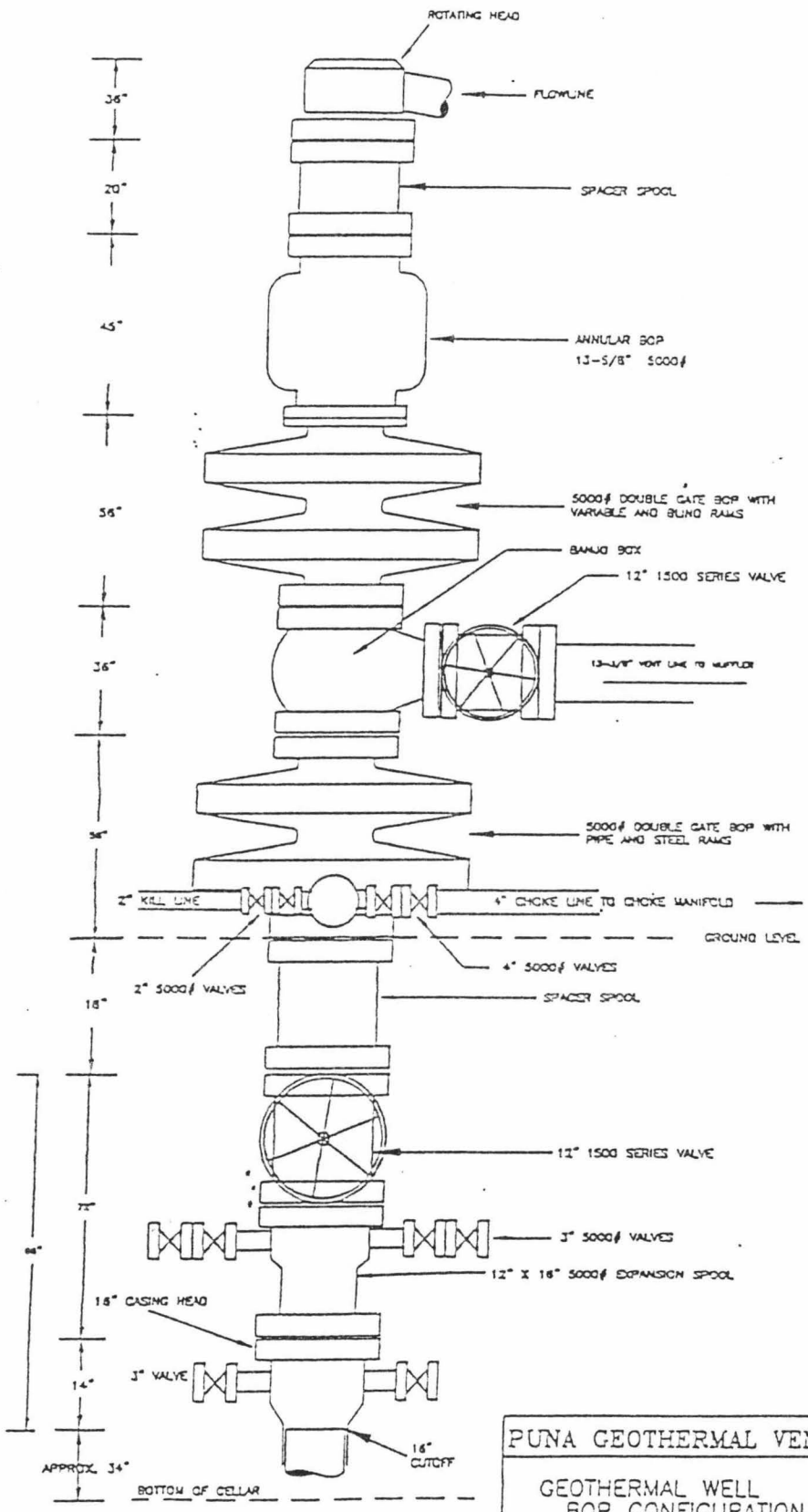

GROUND SURFACE: 820 FT ASL
CELLAR: 10 FT x 10 FT x 10 FT
All depths are approximate and measured from KB: assumed to be 23 ft above ground level
42" HOLE
30" CONDUCTOR CEMENTED TO SURFACE
75 FT
22" .05-WALL K-55, BT&C OR EQUIVALENT CEMENTED TO SURFACE
26" HOLE
1000 FT
16" 97# L-80 BOSS CEMENTED TO SURFACE
CEMENT
20" HOLE
2000 FT
14 3/4" HOLE
11 3/4" 65# C-90 SLOH LINER CEMENTED TO SURFACE
LINER SETTING COLLAR
3000 - 5000 FT
8 5/8" 36# L-80 BT&C SLOTTED LINER HUNG UNCEMENTED
10 5/8" HOLE
4000 - 9000' TD
PUNA GEOTHERMAL VENTURE
PROPOSED
KS-5 CASING SCHEMATIC
R. H. DENTON 3/6/02



PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL 20" BOPE CONFIGURATION		
DATE 7/19/99		REV. 1
BY WM. TEPLOW	FILE:PGV\KS11BOP20.DWG	FIGURE NO. 3-4



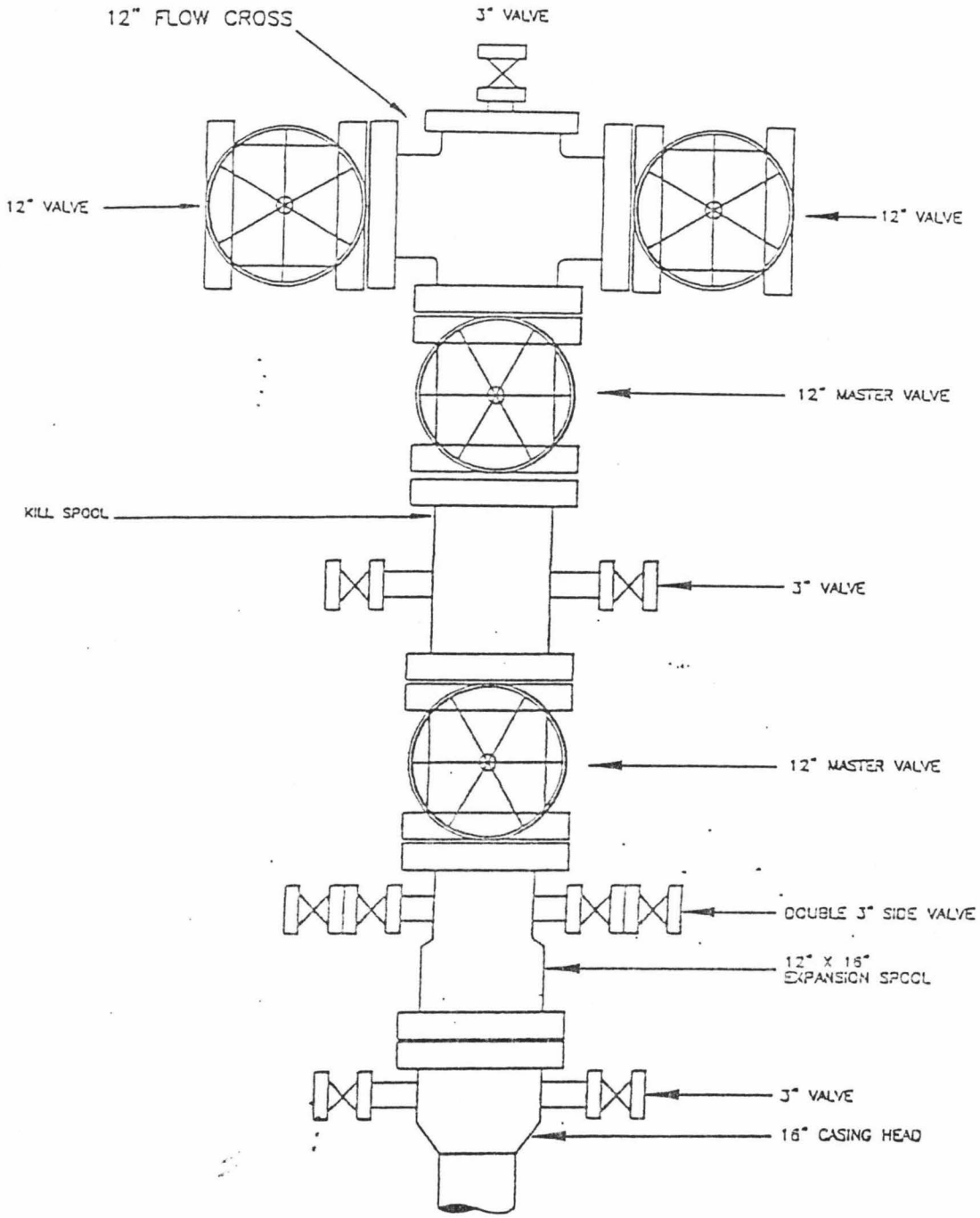
PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL BOP CONFIGURATION FOR 16" CASING		
DATE 7/20/98		REV. 2
BY TEPLOW	file: pgv\K1180P16	FIGURE NO. 3-5



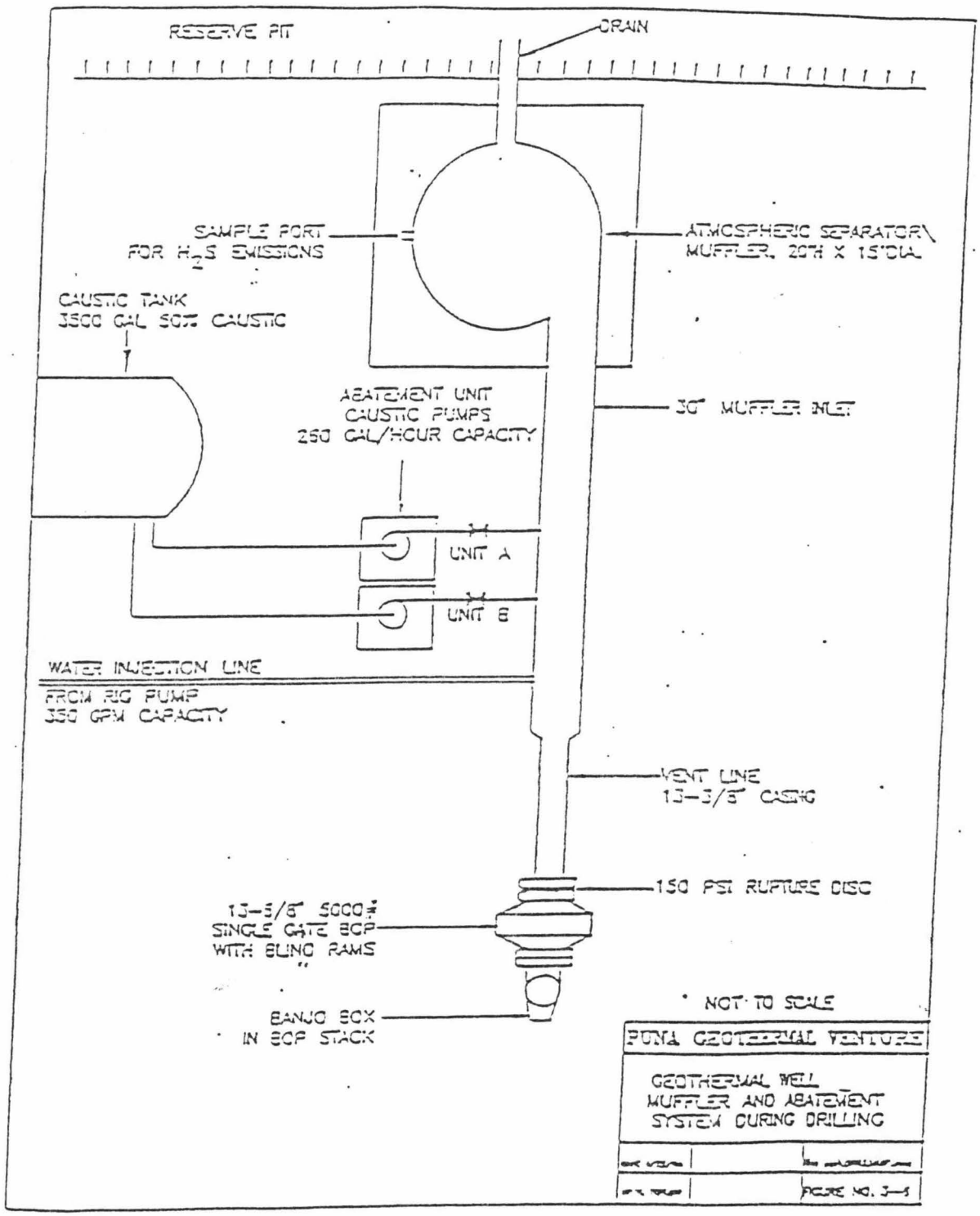
PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL
BOP CONFIGURATION
FOR 11-3/4" CASING

DATE 7/23/98		REV. 2
BY WM. TOPLOW	\Pwrdpjm\well\bop11.dwg	FIGURE NO. J-6



PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELLHEAD CONFIGURATION		
DATE 7/13/99		REV. 1
BY WM. TEPLOW	FILE:PGV\XS11WH.DWG	FIGURE NO. 3-7


RESERVE PIT
DRAIN
SAMPLE PORT
FOR H_2S EMISSIONS
ATMOSPHERIC SEPARATOR\
MUFFLER, 20'H X 15'DIA.
CAUSTIC TANK
3500 GAL 50% CAUSTIC
ABATEMENT UNIT
CAUSTIC PUMPS
250 GAL/HOUR CAPACITY
30" MUFFLER INLET
UNIT A
UNIT B
WATER INJECTION LINE
FROM RIG PUMP
350 GPM CAPACITY
VENT LINE
13-3/8" CASING
150 PSI RUPTURE DISC
13-5/8" 5000#
SINGLE GATE BOP
WITH BLIND RAMS
BANJO BOX
IN BOP STACK
NOT TO SCALE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL
MUFFLER AND ABATEMENT
SYSTEM DURING DRILLING
FIGURE NO. 3-1

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

MAY 13 2002

GEOTHERMAL WELL MODIFICATION DRILLING PERMIT

Kapoho State No. 11 (KS-11)
Kapoho, Puna, Hawaii

To: Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778-0030
(808) 965-6233

Your application dated April 29, 2002, for a modification drilling permit on production well Kapoho State No. 11 (KS-11) on lands located within the Kapoho Section of the Kilauea Lower East Rift Geothermal Resource Subzone and covered under the State of Hawaii, Geothermal Resource Mining Lease No. R-2, is approved.

Well Designation:	Kapoho State No. 11 (KS-11)
Location:	TMK 1-4-01:19, Kapoho, Puna, Hawaii (Well Pad A)
Well Coordinates:	Latitude 19° 28' 48" N Longitude 154° 53' 38" W
State Geothermal Mining Lease:	R-2
Leased to:	Kapoho Land Partnership
Subleased to:	Puna Geothermal Venture
Operator:	COSI Puna, Inc.
Ground Elevation:	610+/-ft. Above Mean Sea Level
Projected Depth:	8500+/-ft. True Vertical Depth

Approval is granted in accordance with the Department of Land and Natural Resources' (Department's) Administrative Rules, Chapter 13-183, Hawaii Administrative Rules (HAR), and subject to the following conditions:

(1) All work shall be performed in accordance with the permission and terms of the occupiers of the land, the Drilling and Completion Program submitted with your application, Chapters 13-183 and 13-184, HAR and all other applicable Federal, State, and County Laws, ordinances, ruled, and regulations;

(2) The permittee, its successors and assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury and death arising out of any act or omission of the applicant, assigns, officers, employees, contractor and agents under this permit or relating to or connected with the granting of this permit;

(3) The permittee shall observe and comply with all valid requirements of County, State, and Federal authorities and regulations to the lands and permittee's operations including, but not limited to, all water and air pollution control laws and those relating to the environment;

(4) The well and bottom-hole location shall be located more than 100 feet from the outer boundary of the parcel of land on which the well is situated, or more than 100 feet from a public road, street, or highway dedicated prior to the commencement of drilling, unless modified by the Chairperson upon request;

(5) The permittee shall notify the Department, in writing, of the date of the start of drilling operations;

(6) Prior to drilling, the permittee shall submit to the Department the bottom-hole target location and direction any proposed deviation;

(7) All Blow-Out Prevention Equipment (BOPE) and cemented casing strings shall be pressure tested before commencing any other operations on the well. The minimum test pressures shall be approximately one-third of the casing internal yield pressure rating, providing that the test pressure shall not be less than 600 psig nor greater than 2500 psig, and shall be applied for a period of thirty minutes. The results of the pressure tests shall be reported on forms provided by the Department;

(8) Class "G" cement shall be used in the casing cementing operations and shall contain a high temperature resistant admix;

(9) A real time monitoring device shall be installed for the driller and a pit alarm system shall be included with this monitoring device. All toolpushers, drillers, and derrickmen shall be schooled in the used of the recommended monitoring equipment;

(10) If changes to the proposed drilling program are contemplated, the permittee shall obtain the Chairperson's approval before executing such changes;

(11) A pressure and temperature survey, to inspect the mechanical integrity of the well, shall be performed after the well has been drilled to total depth, and before commencing the well cleanout flow or injection test;

(12) During the use of the well for testing, monitoring, production and/or injection, the well and well site shall be properly maintained until the well is plugged and abandoned in accordance with Chapter 13-183, HAR;

(13) The permittee shall submit to the Chairperson, the results of any exploration, all drilling and testing records, down-hole surveys of the well, bottom-hole location, date of completion;

(14) A well completion report, an as-built drawing of the well, and the location of the well and the location of the bottom hole location shall be plotted on a U.S.G.S. quad map and shall be filed with the Department within six months after completion of the well;

(15) The bond covering the well shall remain in full force and effect until the well is properly abandoned and the surface is restored as near as possible to its original condition; and

(16) This permit shall expire 365 days from the date of issuance.

GILBERT COLOMA-AGARAN
Department of Land and Natural Resources

MAY 13 2002
Date of Issuance

c: Land Board Members
Hawaii County Planning Dept.
DBEDT
Department of Health
QEQC

PUNA GEOTHERMAL VENTURE
HAWAII

PUNA GEOTHERMAL VENTURE
[redacted]

BANK OF HAWAII
KAIKO'S BRANCH
P.O. BOX 305
HILO, HAWAII 96720

[redacted]

DATE 5/7/02

PAY One Hundred Dollars and 00/100 DOLLARS $ 100.00

TO THE ORDER OF Department of Land & Natural Resources

[redacted]

DETACH AND RETAIN THIS STATEMENT
THE ATTACHED CHECK IS IN PAYMENT OF ITEMS DESCRIBED BELOW.
IF NOT CORRECT PLEASE NOTIFY US PROMPTLY. NO RECEIPT DESIRED.

PUNA GEOTHERMAL VENTURE

DELUXE - FORM WVCY-3 V-2

DATE	DESCRIPTION	AMOUNT
5/7/02	#7908 - KS-11 Sidetrack - 6150-8500	100.00

V-2

DEPARTMENT OF LAND AND NATURAL RESOURCES

DOCUMENT NO. _____ UAC OR ATTACHED WORKSHEET DATE: 5/14/02

F	YR	APP	D	SRC/ OBJ	COST CTR	PROJECT	PH	ACT	AMOUNT	NAME/DESCRIPTION (WANG INPUT)
~~G~~	~~00~~	~~00~~	C	1026	0742				(1) 100.00	PUNA GEOTHERMAL VENTURE BOH #7908
	02316								(2)	KS-11 MODIFICATION
									(3)	
									(4)	
									TOTAL $100.00	

REMARKS: LINE (1) _____

LINE (2) _____

LINE (3) _____

LINE (4) _____

05/14/02 [redacted] CHECK 100.00

41670

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

April 29, 2002

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Subject: KS-11 Modified Drilling Permit

Dear Mr. Coloma-Agaran:

Enclosed please find an application for a KS-11 Modification Permit, and a check for $100.00. Pursuant to the Department of Land and Natural Resources (DLNR) Administrative Rule 13-183-56, and as a follow up to Puna Geothermal Venture's (PGV's) letter dated April 12, 2002, PGV hereby requests approval to perform rework options at production well KS-11.

These rework options could include, but not be limited to the following:

1) Set a cement plug approximately 200 to 400 feet in linear length, at or near the bottom of the 11¾" casing, between approximately 4500 to 5000 feet,

2) Cut a window in the 11¾" casing at approximately 3500 to 4500 feet, and

3) Side-track the bottom section of the hole, then continue drilling to the existing approximate measured depth, at a final target location that's parallel from the existing open hole section.

A second option would be to follow the steps above, with the exception of the final target location being the original KS-11 bottom hole target at ~9,000 feet. Another option would be to follow the three steps mentioned above, then continue drilling to a final target that would be completely separate from the two previous options mentioned.

Should the said options be necessary, PGV respectfully requests a modification to the Plan of Operation to change the physical characteristics of the KS-11 wellbore in order to get the well back to full working capability. Prior to commencing any work, contractors, consultants, and plant personnel will have completed discussing in full detail and a work plan developed. Discussions will include safety, environmental, equipment, and manpower requirements.

The proposed rework would commence on May 24, 2002, or shortly thereafter. The schedule could be shortened, extended, or revised, dependent on the progress of the work planned. A well

flow clean out may be required prior to placing the well back in service. An updated well completion report will be submitted showing any changes made to the well.

In general, the following equipment will be used but not limited to:

1) Blowout Preventer Equipment (BOPE) will be used to prevent the flow of fluids out of the well and into the atmosphere.

2) Abatement equipment will be used to prevent the release of hydrogen sulfide.

3) A drilling rig will be used to perform workover.

Should you have any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

Enclosure: Application for Modified Drilling Permit

cc: Eric Tanaka, DLNR
Mike Kaleikini
Bill Wiebe

APPLICATION FOR PERMIT *MODIFICATION* TO RE-DRILL A PORTION OF GEOTHERMAL WELL KAPOHO STATE 11 ON RESERVED LANDS, KAPOHO, PUNA HAWAII

Complying with Department of Land and Natural Resources (DLNR) Administrative Rule, Title 13, Chapter 183, Section 65, Puna Geothermal Venture (PGV) herewith makes application for a Permit-to-Drill ***modification*** for approval by the Hawaii Board of Land and Natural Resources.

1. **Applicant:**

Puna Geothermal Venture
P.O. Box 30
14-3860 Kapoho Pahoa Road
Pahoa, Hawaii 96778-0030
(808) 965-6233

PUNA GEOTHERMAL VENTURE

By: _____
Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture

Owner of Mining Rights:

Kapoho Land Partnership

Land Owner:

Kapoho Land and Development Company, Limited

2. **Proposed Well Designation:**

Kapoho State 11 (KS-11) off Wellpad A.

3. A tax key map, designating the approximate location of the drill site for KS-11 off Wellpad A located on State Geothermal Mining Lease R-2; a topographic map, designating the approximate surface elevation at Wellpad A of 610 feet above mean sea level; and a PGV Project map, designating the relative locations of KS-11 and Wellpad A are contained in Attachment I.

4. The proposed PGV Project geothermal well KS-11 has been designed to intersect near-vertical fractures, approximately 4000 feet to approximately 9000 feet true vertical depth (TVD). At least one drilling target was for the purpose of providing geothermal resources to power the PGV project power plant, previously approved in the Plan-of-Operation approved March 10, 1989, by the Board of Land and Natural Resources. At least one other drilling target was for the purpose of either providing a geothermal resource for, or injecting geothermal fluids and non-condensible gases from, the operation of the power plant.

5. A detailed Summary-of-Drilling Procedures is enclosed in Attachment II.

6. A detailed Well Drilling and Completion Plan and a Vertical Section of the KS-11 well are contained in Attachment III.

7. A Summary-of-Drilling Reporting Criteria is enclosed in Attachment IV.

8. A description of Lithologic ("Mud") Logging Procedures is enclosed in Attachment V.

9. A multi-well drilling bond ($250,000) has previously been filed with the State of Hawaii.

10. Puna Geothermal Venture agrees to perform such drilling as outlined in this application and agrees to maintain the well in accordance with Title 13, Chapter 183, State of Hawaii, and all Federal and County geothermal regulations.

KS-11 PERMIT MODIFICATION: ATTACHMENT I

PUNA GEOTHERMAL VENTURE
MODIFICATION APPLICATION TO RE-DRILL KAPOHO STATE 11
A GEOTHERMAL WELL

I. General Information

a.	Well Designation:	Kapoho State 11
b.	Location:	TMK 1-04-01:19
	Kapoho, Puna, Hawaii (Figure 1)	
c.	State Geothermal Mining Lease:	R-2
d.	Owner of Mineral Rights:	Kapoho Land Partnership
e.	Subleased to:	Puna Geothermal Venture
f.	Operator:	COSI Puna, Inc.

II. Well Data

a.	Well Site:	Well Pad A (Figure 2)
b.	Well map coordinates:	154 53' 38" W
		19 28' 48" N
c.	Well Type:	Development Well
d.	Surface Elevation:	610 feet AMSL (Figure 3)
e.	Projected Depth:	Approximately +/- 9000 feet True Vertical Depth (TVD)
f.	Target:	Fractured basalt below 4000 feet Measured Depth (MD)

III. Geology

Depth (MD):	Formation:
0 - 627 ft.	Unsaturated subaerial basalt flows and intercalated cinder scoria.
627 ft.	Water Table
627 - 3000 ft.	Saturated subaerial basalt flows and intercalated cinder scoria; rare dikes.
3000 - 4000 ft.	Interbedded hyaloclastite deposits and minor subaerial grading into submarine basalt flows; localized dike swarms.
4000 - 6500 ft.	Submarine basalt flows cross-cut by basalt dikes and possibly high-permeability, near-vertical fractures.
6500 - TD	Basaltic dike complex with locally recognizable submarine basalt flows.

KS-11 PERMIT MODIFICATION: ATTACHMENT II

PUNA GEOTHERMAL VENTURE
KS-11 RE-DRILLING PROCEDURES
(Except as noted, all depths are referenced to KB.)

1. Move in suitable rig and associated equipment. Rig up all accoutrements.

    1.1. Notify DLNR 24 hours prior to rig up.
    1.2. Install soundproofing.
    1.3. Install direct communications between rig floor, tool pusher and company man.
    1.4. Comply with all sections of the Plan of Operations that pertain to drilling.
    1.5. Instruct drillers to remain on the floor at all times during drilling operations.
    1.6. Adhere to the Drilling Reporting Criteria.
    1.7. Provide DLNR with copies of the tour sheets daily.
    1.8. Conduct pre-spud meeting covering well control, H2S, emergency medical evacuation, safety procedures and well program.
    1.9. Be sure location is secured with proper berms and ditches prior to spud.
    1.10. Kill well Refer to PGV procedure "Well Kill".

2. Install 5000 # BOPE as per attachment: Geothermal well KS-11
    BOP Configuration
    For 11 ¾" casing

3. Install Bridge Plug or equivilent at approximately 4500 feet.

4. Install cement plug approximately 200 to 400 linier feet on top of Bridge Plug.

5. Cut window in 11 ¾" casing at approximately 3500 to 4500 feet.

6. Drill 10-5/8 " hole to +/- 8000 feet TVD or until sufficient production is encountered.

7. Continue drilling 10-5/8" TD.

    7.1. Use mud weight that provides approximately2150 psi hydrostatic head pressure at the casing shoe and maintain mud weight sufficient to provide approximately 2150 hydrostatic while drilling.
    7.2. Take surveys every 120 feet and include MRT.
    7.3. Catch 10-foot grab samples of drill cuttings.
    7.4. Keep close watch on mud properties. Weight up as needed to control well. Keep pH at approximately 9
    7.5. Be sure all monitoring equipment is in good working order.
    7.6. Watch closely for flow or loss and for changes in mineralogy indicative of high temperature geothermal reservoir.
    7.7. Run both mud coolers.

7.8. If well indicates flow or shut in pressure during trips, cool hole with circulation and recheck hole parameters.
7.9. Stroke Master Valve from full open to close and function test BOPE on every trip.

8. T.D. will be Kelly down after total loss circulation occurs or one connection below.

8.5. Place well on kill line at 5-7 barrels per minute and strip out of the well bore to shoe.
8.6. Monitor well while stripping out and maintain vacuum.
8.7. Notify Drilling Supervisor and Drilling Manager immediately.

9. Upon reaching shoe, be sure well is shut in.

9.5. Displace drill string with soapy water.
9.6. Build mud volume to full capacity with proper kill weight mud.
9.7. Kill well with mud and place well on kill line at 5-7 barrels per minute.
9.8. Strip out of the hole and monitor well head pressure closely. Maintain well on vacuum of at least –1 (negative one) psi well head pressure.
9.9. Close blind and start pumping water at 8-10 barrels per minute for at least 5 hole volumes. Monitor well head pressure (WHP).
9.10. Close Master Valve. Monitor WHP.

10. Lay down drill pipe and tools in mouse hole. Tighten all flanges on well head equipment and valves.

11. Tear out BOPE and install second 12" 5000# Master Valve. Install companion flange and swab valve.

12. Install Barton recorder and dial gauge to monitor well pressure.

13. Secure well, rig down and move rig out.

14. Release well to O&M. Note release time on tour sheets.

15. Submit well completion records including: Well record sheet, bit record casing details, pipe measurement records, well schematic diagram, well head assembly diagram and serial numbers of well head valves to Puna Geothermal Office within one week.

KS-11 PERMIT MODIFICATION: ATTACHMENT III
PUNA GEOTHERMAL VENTURE
DEVELOPMENT WELL DRILLING PLAN
FOR WELL KS-11

BLOWOUT PREVENTION EQUIPMENT (13-5/8" BOPE) 10-5/8" HOLE (Figure 3-6):

Blowout prevention equipment to drill the 10-5/8" section of hole should consist of a 12" 5000# gate valve, 12" 5000# x 13-5/8" 5000# double-stud adapter (DSA), two 13-5/8" 5000# double gate preventers, a 13-5/8" 5000# annular preventer, a banjo box/flow tee/equivalent with a rupture disk and a single-gate preventer on the side outlet, a rotating drilling head, choke, and kill line (Figure 3-6). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment and muffler on blooie line and choke line. Provisions will be made to abate any well flow from the choke line or the blooie line.

DRILLING 10-5/8" HOLE:

Drill out from underneath the 11-3/4" casing on water with a 10-5/8" bit and slick bottom hole assembly. Perform leak-off test and note test results on IADC tower report. Squeeze if required. Notify appropriate State agencies 24 hours prior to testing. Trip for packed BHA and continue drilling ahead on mud.

At total depth (TD) circulate out mud with fresh water. Trip-out of hole, nipple down BOPE and rig up for flow test. Upon completion of flow test install final wellhead for production well, as shown in Figure 3-7.

KS-11 PERMIT MODIFICATION: ATTACHMENT IV
PUNA GEOTHERMAL VENTURE
DRILLING REPORTING CRITERIA

1. The Drilling Supervisor shall report to the PGV Drilling Engineer or his designated relief on the day-to-day operations.

2. As closely as possible, the Drilling Supervisor will follow the drilling program for a particular well as provided by the Drilling Engineer. There will be changes in the drilling program as the well progresses, and these changes must be discussed with the Drilling Engineer before action is taken.

3. A mud program will be outlined in the Drilling Program, and this program should be followed as closely as possible. The Drilling Supervisor shall have ample latitude to change the mud program as dictated by the actual drilling conditions.

4. Historical drilling data have been developed regarding the Puna Geothermal Project, and this data should be used to the best advantage in drilling wells within the project.

5. In and out mud temperatures and maximum recording temperatures will be logged on the IADC tower report.

6. When drilling, special precautions must be taken when encountering any lost circulation zones or drilling breaks.

7. If a drilling break is encountered while drilling, then the pipe should be picked up to properly place tool joint and bottoms up should be circulated around. The PGV Drilling Supervisor should be immediately notified along with the contractor's supervisor. A temperature survey should be run whenever a drilling break is encountered. An interpretation of the survey should be made by the Drilling Engineer before drilling further. It is important not to drill ahead with excessive temperature in the mud returns.

8. The driller should also note in the IADC tower report any gains or losses in the mud pit volume. Any significant mud loss should be reported to the PGV supervisor(s) and the Contractor's supervisor(s). If any continuous or significant mud gain is encountered, then the driller should pick up the pipe and check for flow and notify the supervisors. If flow is observed, then the well will be shut in immediately.

9. Based on past experience at the Puna Geothermal Project, it is imperative that constant supervision of the well be accomplished once drilling is undertaken. PGV Supervisors will be in charge of all activities on location. PGV Supervisors will report to the PGV Drilling Engineer or Drilling Manager.

11. Drilling Supervisors will spend sufficient time together at the rig during change-out to exchange information on the current activities. Drilling Supervisors will be on the floor, on the pump truck, in the wireline unit, etc. for all critical operations.

12. The Drilling Engineer will be responsible for engineering programs with input from the Drilling Supervisors. The Drilling Engineer will also advise and assist the Drilling Managers and Supervisors.

13. Contractor's supervisors will report to the Drilling Supervisor on location. They will also be on the floor during all crew changes.

14. Reporting procedures for crews will be the responsibility of the drilling contractor. Drillers will log all rig operations on the IADC daily tower report, including the depths of all work performed. Rig crew will assist service company personnel as directed by the contractor's supervisor.

KS-11 PERMIT MODIFICATION: ATTACHMENT V
PUNA GEOTHERMAL VENTURE
PROCEDURES FOR LITHOLOGIC ("MUD") LOGGING

While drilling, depths are recorded on a Bristol chart (a circular chart matching time versus depth). As a single joint is drilled, each ten-foot interval (i.e., 100, 110, 120, etc.) is marked and labeled on the chart. A lag time (the interval of time, measured in minutes, required to circulate drilling fluids from the bit to the surface) is calculated based on hole size and pump rates and a marker is set to indicate when a marked depth reaches the surface.

When drilling fluids containing suspended drill cuttings derived from a given interval reach the surface, such fluids travel down the flow line and over the mesh shaker screens. After the latest ten-foot interval has accumulated at the base of the shakers, the mud logger obtains a representative sample of the drill cuttings. The sample is then washed of the drilling fluid. One portion of the cuttings, the wet sample, is placed in a plastic bag and the remainder is dried and bagged in sample sets.

A small amount is retained to view under a stereomicroscope. The cuttings from each ten-foot interval are then visually and physically evaluated. Detailed written descriptions of each ten-foot interval are entered on work sheets which are subsequently summarized onto the mud log data sheet. The lithologic descriptions include rock type, color, texture, hardness, structural characteristics, alteration (if any) and secondary mineralization.

PROCEDURE

PRODUCTION WELL SHUT IN

1. Upon ramp down of power and under the instruction of CSC operator close east and west 10" 1500 series Velan valves (2) 100%.
2. Record wellhead pressure @ flow tee and report to CSC operator.
3. Close upper master valve 100%.
4. Close lower master valve 100%.

The well is now shut in and ready to be put on minimum bleed or killed. If the decision is made to kill the well do not close the lower master valve.

PROCEDURE

PRODUCTION WELL KILL

1. Follow steps 1-3 on procedure for production well shut in.

2. Prep kill pump by following procedure for kill pump PM.

3. Hook up kill pump discharge line to kill line and open 3" 5M kill line isolation valve located ~ 25' south of wellhead on kill line 100%.

4. Open 3" 5M kill line valves (2) located on wellhead 100%. Open outside valve first and then slowly open inside valve pressurizing kill line up to the 5M-check valve.

5. Engage kill pump in low gear and begin pressurizing kill line to 5000 psi.

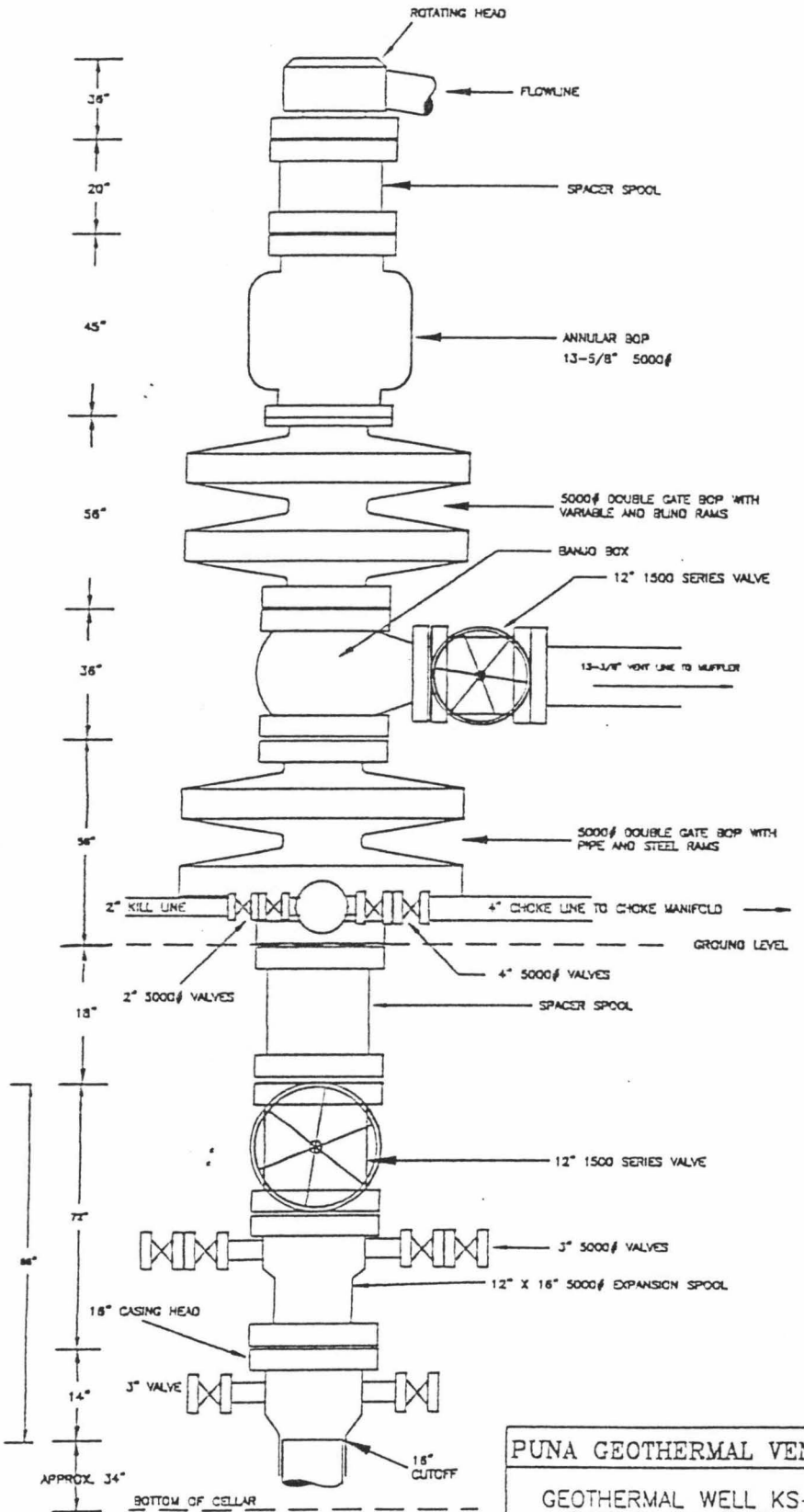
   NOTE: At 5000 psi the rupture disc will burst allowing flow into well. This will be detected when pump pressure decreases to ~ wellhead pressure.

6. Establish a flow rate of ~ .25 -.50 bbls/ min and pump water for 8-12 hrs.

   NOTE: Throughout pumping evolution watch well head closely for signs of cooling. Pumping may be stopped at any time if it is felt that the well is being cooled to fast i.e., wellhead shrinkage, wellhead pressure etc. If there is a major leak, it may be necessary to pump water at a higher rate to effectively cool and kill the well.

7. After 8-12 hrs. the well should be dead and flow rates may be increased to 1-2 bbls/min.

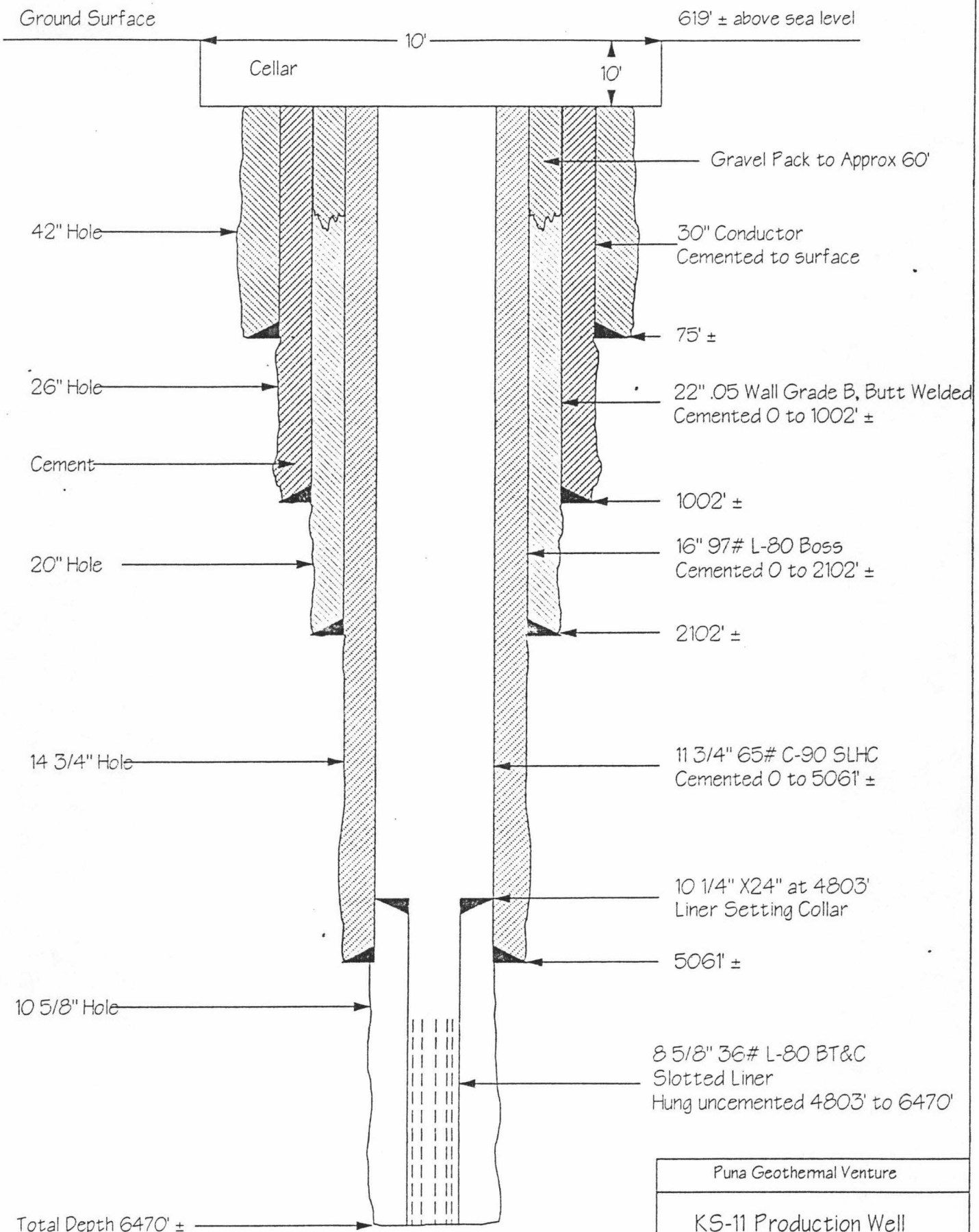
8. After ~ 16-20 hrs. the well should be ready for logging, workover and /or cementing.



PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL KS-11
BOP CONFIGURATION
FOR 11-3/4" CASING

DATE 7/20/98		REV. 2
BY WAL TEPLOW	\\acdgv\ks11bop11.dwg	FIGURE NO. 3-6



Puna Geothermal Venture	
KS-11 Production Well	
9 March, 2001	R. Brady

KS-11 PERMIT MODIFICATION: ATTACHMENT IV
PUNA GEOTHERMAL VENTURE
DRILLING REPORTING CRITERIA

1. The Drilling Supervisor shall report to the PGV Drilling Engineer or his designated relief on the day-to-day operations.

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4. Historical drilling data have been developed regarding the Puna Geothermal Project, and this data should be used to the best advantage in drilling wells within the project.

5. In and out mud temperatures and maximum recording temperatures will be logged on the IADC tower report.

6. When drilling, special precautions must be taken when encountering any lost circulation zones or drilling breaks.

7. If a drilling break is encountered while drilling, then the pipe should be picked up to properly place tool joint and bottoms up should be circulated around. The PGV Drilling Supervisor should be immediately notified along with the contractor's supervisor. A temperature survey should be run whenever a drilling break is encountered. An interpretation of the survey should be made by the Drilling Engineer before drilling further. It is important not to drill ahead with excessive temperature in the mud returns.

8. The driller should also note in the IADC tower report any gains or losses in the mud pit volume. Any significant mud loss should be reported to the PGV supervisor(s) and the Contractor's supervisor(s). If any continuous or significant mud gain is encountered, then the driller should pick up the pipe and check for flow and notify the supervisors. If flow is observed, then the well will be shut in immediately.

9. Based on past experience at the Puna Geothermal Project, it is imperative that constant supervision of the well be accomplished once drilling is undertaken. PGV Supervisors will be in charge of all activities on location. PGV Supervisors will report to the PGV Drilling Engineer or Drilling Manager.

11. Drilling Supervisors will spend sufficient time together at the rig during change-out to exchange information on the current activities. Drilling Supervisors will be on the floor, on the pump truck, in the wireline unit, etc. for all critical operations.

12. The Drilling Engineer will be responsible for engineering programs with input from the Drilling Supervisors. The Drilling Engineer will also advise and assist the Drilling Managers and Supervisors.

13. Contractor's supervisors will report to the Drilling Supervisor on location. They will also be on the floor during all crew changes.

14. Reporting procedures for crews will be the responsibility of the drilling contractor. Drillers will log all rig operations on the IADC daily tower report, including the depths of all work performed. Rig crew will assist service company personnel as directed by the contractor's supervisor.

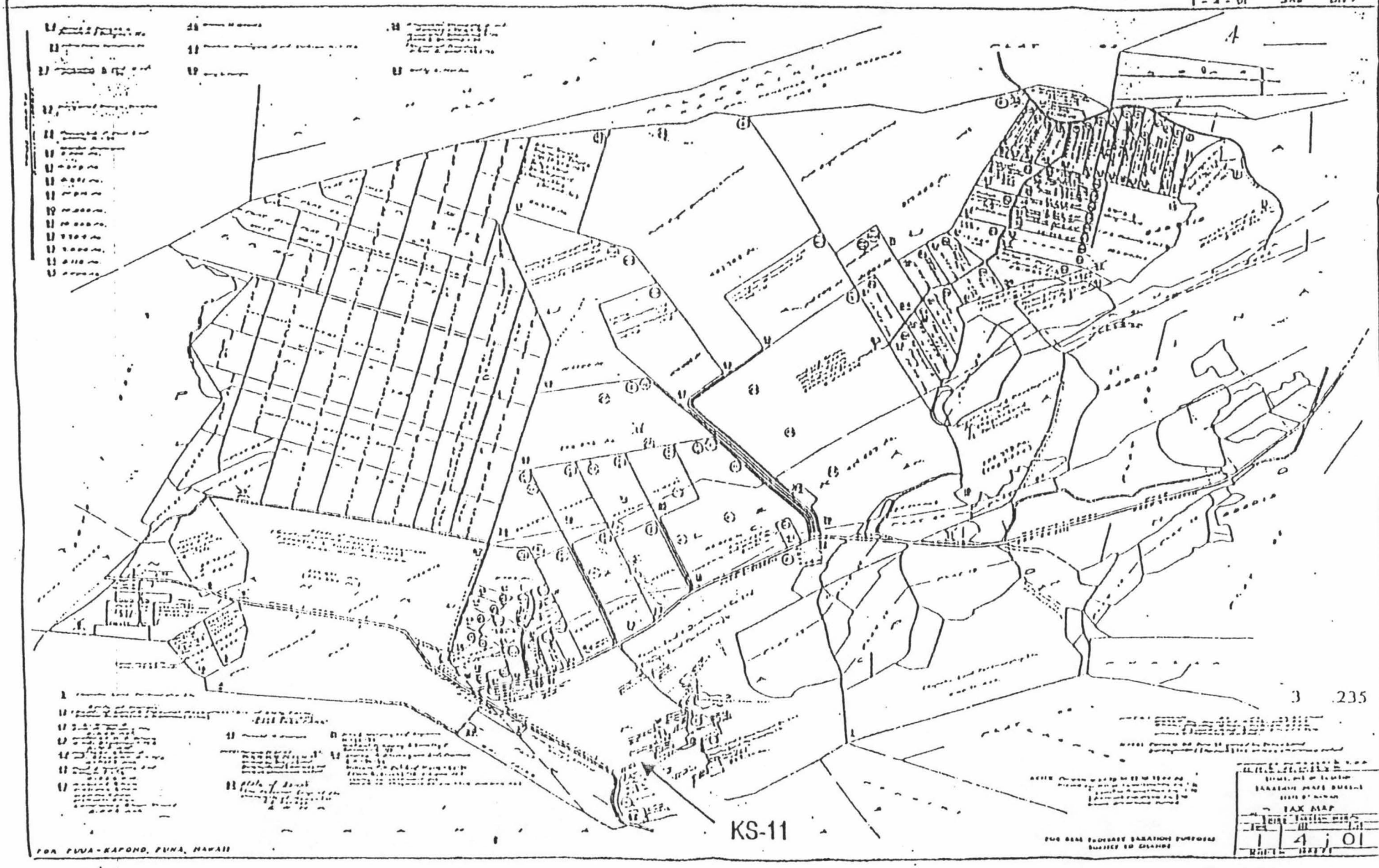
KS-11 PERMIT MODIFICATION: ATTACHMENT V
PUNA GEOTHERMAL VENTURE
PROCEDURES FOR LITHOLOGIC ("MUD") LOGGING

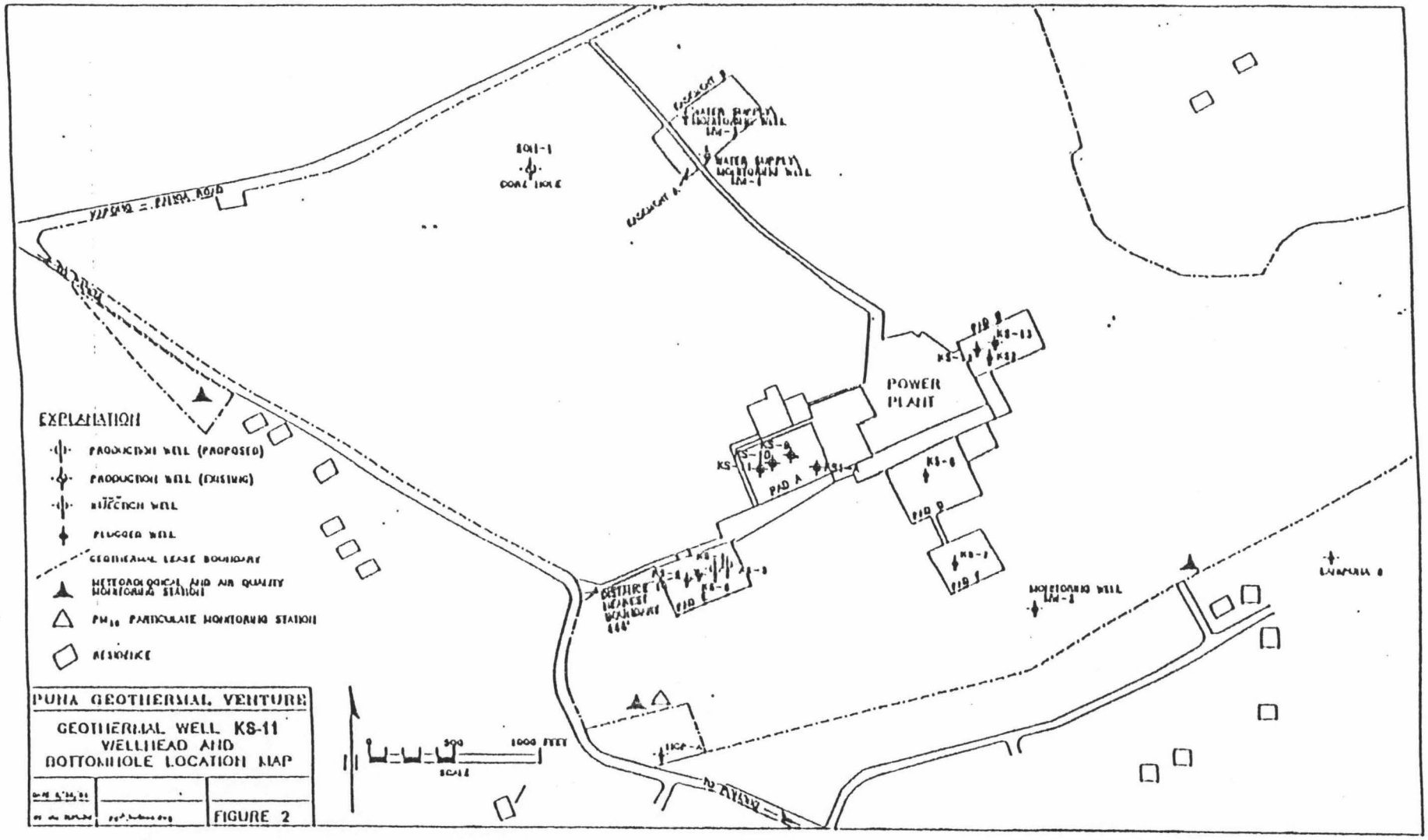
While drilling, depths are recorded on a Bristol chart (a circular chart matching time versus depth). As a single joint is drilled, each ten-foot interval (i.e., 100, 110, 120, etc.) is marked and labeled on the chart. A lag time (the interval of time, measured in minutes, required to circulate drilling fluids from the bit to the surface) is calculated based on hole size and pump rates and a marker is set to indicate when a marked depth reaches the surface.

When drilling fluids containing suspended drill cuttings derived from a given interval reach the surface, such fluids travel down the flow line and over the mesh shaker screens. After the latest ten-foot interval has accumulated at the base of the shakers, the mud logger obtains a representative sample of the drill cuttings. The sample is then washed of the drilling fluid. One portion of the cuttings, the wet sample, is placed in a plastic bag and the remainder is dried and bagged in sample sets.

A small amount is retained to view under a stereomicroscope. The cuttings from each ten-foot interval are then visually and physically evaluated. Detailed written descriptions of each ten-foot interval are entered on work sheets which are subsequently summarized onto the mud log data sheet. The lithologic descriptions include rock type, color, texture, hardness, structural characteristics, alteration (if any) and secondary mineralization.

FIGURE 1




EXPLANATION
PRODUCTION WELL (PROPOSED)
PRODUCTION WELL (EXISTING)
INJECTION WELL
PLUGGED WELL
GEOTHERMAL LEASE BOUNDARY
METEOROLOGICAL AND AIR QUALITY MONITORING STATION
PM_{10} PARTICULATE MONITORING STATION
RESIDENCE
POWER PLANT
PAD A
PAD B
PAD C
PAD D
PAD E
PAD F
PAD G
KS-1
KS-2
KS-3
KS-4
KS-5
KS-6
KS-7
KS-8
KS-9
KS-10
KS-11
KS-12
KS-13
BOH-1
DOME TANK
WATER SUPPLY MONITORING WELL LM-1
MONITORING WELL LM-2
GEOTHERMAL LEASE BOUNDARY
500
1000 FEET
SCALE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL KS-11
WELLHEAD AND
BOTTOMHOLE LOCATION MAP
FIGURE 2

ISLAND OF HAWAII—PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)

KS-11

FIGURE 3

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

OCT 31 2002

GEOTHERMAL WELL DRILLING PERMIT

Kapoho State 6 (KS-6)
Kapoho, Puna, Hawaii

TO: Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778-0030
(808) 965-6233

Your application dated October 9, 2002, for a permit to drill a geothermal well on land located within the Kapoho Section of the Kilauea Lower East Rift Geothermal Resource Subzone and covered under the State of Hawaii, Geothermal Resource Mining Lease No. R-2 is approved.

Well Designation:	Kapoho State 6 (KS-6)
Location:	TMK 1-04-01:02, Kapoho, Puna, Hawaii (Well Pad E)
Well Coordinates:	154° 53' 54" W 19° 28' 42" N
State Geothermal Mining Lease:	R-2
Leased to:	Kapoho Land Partnership
Subleased to:	Puna Geothermal Venture
Operator:	COSI Puna, Inc.
Ground Elevation:	619' Above Mean Sea Level
Projected Depth:	8,500' +/- True Vertical Depth

Approval is granted in accordance with the Department of Land and Natural Resources' (Department's) Administrative Rules, Chapter 13-183, Hawaii Administrative Rules (HAR), and under the following conditions:

(1) All work shall be performed in accordance with the permission and terms of the occupiers of the land, the drilling and completion program submitted with your application, the Department's Administrative Rules (Chapters 13-183 and 13-184, HAR), and all other applicable Federal, State, and County laws, ordinances, rules and regulations;

(2) The permittee, its successors and assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury and death arising out of any act or omission of the applicant, assigns, officers, employees, contractors and agents under this permit or relating to or connected with the granting of this permit;

(3) The permittee shall observe and comply with all valid requirements of County, State, and Federal authorities and regulations to the land and permittee's operations including, but not limited to, all water and air pollution control laws and those relating to the environment;

(4) The well and bottom-hole location shall be located more than 100 feet from the outer boundary of the parcel of land on which the well is situated, or more than 100 feet from a public road, street or highway dedicated prior to the commencement of drilling, unless modified by the Chairperson upon request;

(5) The permittee shall notify the Department, in writing, of the date of the start of the drilling operations;

(6) Prior to drilling, the permittee shall submit to the Department the bottom-hole target location and the direction of any proposed deviation;

(7) All Blow-Out Prevention Equipment (BOPE) and cemented casing strings shall be pressure tested before commencing any other operations on the well. The minimum test pressures shall be approximately one-third of the casing internal yield pressure rating, providing the test pressure shall not be less than 600 psig nor greater than 2,500 psig, and shall be applied for a period of thirty minutes. The results of the pressure tests shall be reported on forms provided by the Department;

(8) Class "G" cement shall be used in the casing cementing operations and shall contain a high temperature resistant admix;

(9) A real time monitoring device shall be installed for the driller and a pit alarm system shall be included with this monitoring device. All toolpushers, drillers, and derrickmen shall be schooled in the use of the recommended monitoring equipment;

(10) If changes to the proposed drilling programs are contemplated, the permittee shall obtain the Chairperson's approval before executing such changes;

(11) When drilling has reached a depth of not more than 50 feet below sea level, the Department's representative shall be notified, with reasonable time allowed for travel to the site, to witness the retrieval of a representative ground water sample and the measurement of the static water level. The permittee shall have the sample analyzed by an independent laboratory and have the results submitted to the Department;

(12) A pressure and temperature survey, to inspect the mechanical integrity of the well, shall be performed after the well has been drilled to total depth, and before commencing the well cleanout flow or injection test;

(13) During the use of the well for testing, monitoring, production and/or injection purposes, the well and site shall be properly maintained until the well is plugged and abandoned in accordance with the Department's Administrative Rules, Chapter 13-183, HAR;

(14) The permittee shall submit to the Chairperson, the results of any exploration, all drilling and testing records, down-hole surveys of the well, bottom-hole location, date of completion, and a survey of the well location and elevation above mean sea level taken by a Hawaii licensed surveyor within six months after completion of the well;

(15) A well completion report, an as-built drawing of the well, and the location of the well plotted on a U.S.G.S. quad map shall be filed with the Department within six months after completion of the well;

(16) The bond covering the well shall remain in full force and effect until the well is properly abandoned and the surface is restored as near as possible to its original condition; and

(17) This permit shall expire 365 days from the date of issuance.

GILBERT COLOMA-AGARAN, Chairperson
Department of Land and Natural Resources

OCT 31 2002
Date of Issuance

c: Land Board Members
Hawaii County Planning Department
Department of Business, Economic Development and Tourism
Department of Health
Office of Environmental Quality Control

APPLICATION FOR PERMIT TO DRILL
PROPOSED GEOTHERMAL WELL KAPOHO STATE 6
ON RESERVED LANDS, KAPOHO, PUNA, HAWAII

Complying with Department of Land and Natural Resources (DLNR) Administrative Rule, Title 13, Chapter 183, Section 65, Puna Geothermal Venture (PGV) herewith makes application for a Permit-to-Drill for approval by the Hawaii Board of Land and Natural Resources.

1. **Applicant:**

Puna Geothermal Venture
P.O. Box 30
14-3860 Kapoho Pahoa Road
Pahoa, Hawaii 96778-0030
(808) 965-6233

PUNA GEOTHERMAL VENTURE

By: Michael K. Kaleikini for
Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture

Owner of Mining Rights:

Kapoho Land Partnership

Land Owner:

Kapoho Land and Development Company, Limited

2. **Proposed Well Designation:**

Kapoho State 6 (KS-6) off Wellpad E.

3. A tax key map, designating the approximate location of the drill site for KS-6 off Wellpad E located on State Geothermal Mining Lease R-2; a topographic map, designating the approximate surface elevation at Wellpad E of 619 feet above mean sea level; and a PGV Project map, designating the relative locations of KS-6 and Wellpad E are contained in Attachment I.

4. The proposed PGV geothermal well KS-6 will be directionally drilled to a target area which lies at 330 feet east, 880 feet south of the KS-6 wellhead location, at a depth of approximately 9000 feet true vertical depth (TVD), The well will not approach closer than 100 feet from the vertical boundary line of the leased property. The well will be drilled for the purpose of providing additional production capacity to fulfill PGV's contractual needs.

A secondary target could also be for additional injection capacity for the disposal of PGV's spent geothermal fluid and gases, which are permitted under the Plan-of-Operation approved March 10, 1989, by the Board of Land and Natural Resources. The target area is expected to be in fractured basalt with relatively low permeability and will provide additional production capacity.

5. A detailed Summary-of-Drilling Procedures is enclosed in Attachment II.

6. A detailed Well Drilling and Completion Program, a drill site Plan, and a Vertical Section of the KS-6 well are contained in Attachment III.

7. A Summary-of-Drilling Reporting Criteria is enclosed in Attachment IV.

8. A description of Lithologic Logging Procedures is enclosed in Attachment V.

9. A multi-well drilling bond ($250,000) has previously been filed with the State of Hawaii.

10. Puna Geothermal Venture agrees to perform such drilling as outlined in this application and agrees to maintain the well in accordance with Title 13, Chapter 183, State of Hawaii, and all Federal and County geothermal regulations.

ATTACHMENT I

PUNA GEOTHERMAL VENTURE
APPLICATION TO DRILL KAPOHO STATE 6
A GEOTHERMAL WELL

I. General Information

a.	Well Designation:	Kapoho State 6 (KS-6)
b.	Location:	TMK 1-04-1:02 Kapoho, Puna, Hawaii (Figure 1)
c.	State Geothermal Mining Lease:	R-2
d.	Owner of Mineral Rights:	Kapoho Land Partnership
e.	Subleased to:	Puna Geothermal Venture
f.	Operator:	COSI Puna, Inc.

II. Well Data

a.	Well Site:	Well Pad E (Figure 2)
b.	Well Map Coordinates:	154 53' 54" W 19 28' 42" N
c.	Well Type:	Development Well
d.	Surface Elevation:	619 feet AMSL (Figure 3)
e.	Projected Depth:	8500 feet True Vertical Depth (TVD)
f.	Target:	Fractured basalt below 4000' Measured Depth (MD)

KS-6 Well will be directionally drilled to a target area that lies at 330 feet east, 880 feet south of the KS-6 wellhead location, at a depth of approximately 9000 feet TVD (Figure 2). The target is expected to be fractured basalt with relatively high-permeability, which will provide additional production to PGV's power plant.

III. Geology

Depth (MD):	Formation:
0 - 627 ft.	Unsaturated subaerial basalt flows and intercalated cinder scoria.
627 ft.	Water Table
627 - 3000 ft.	Saturated subaerial basalt flows and intercalated cinder scoria; rare dikes.
3000 - 4000 ft.	Interbedded hyaloclastite deposits and minor subaerial grading into submarine basalt flows; localized dike swarms.
4000 - 6500 ft	Submarine basalt flows cross-cut by basalt dikes and possibly high-permeability, near-vertical fractures.
6500 - TD	Basaltic dike complex with locally recognizable submarine basalt flows.

ATTACHMENT II

PUNA GEOTHERMAL VENTURE
KS-6 DRILLING PROCEDURES
(Except as noted, all depths are referenced to KB.)

Location:
Elevation:
AFE#

1. Move in suitable rig and associated equipment. Rig up all accoutrements prior to spudding.

    1.1. Notify DLNR 24 hours prior to rig up.
    1.2. Install soundproofing.
    1.3. Install direct communications between rig floor, tool pusher and company man.
    1.4. Comply with all sections of the Plan of Operations that pertain to drilling.
    1.5. Instruct drillers to remain on the floor at all times during drilling operations.
    1.6. Adhere to the Drilling Reporting Criteria.
    1.7. Provide DLNR with copies of the tour sheets daily.
    1.8. Conduct pre-spud meeting covering well control, H2S, emergency medical evacuation, safety procedures and well program.
    1.9. Be sure location is secured with proper berms and ditches prior to spud.
    1.10. Weld on 30" conductor pipe and rig up flow line.
    1.11. Conduct Safety Inspections.
    1.12. Fill all mud tanks and storage tanks with water. Minimum total water delivery should be 30+ bbl/minute for possible well control. (See mud program)
    1.13. Rig up H2S monitors and all safety equipment.

2. Drill 26" hole to +/- 700 feet.

    2.1. Make up a 26" stabilized bit on a mud motor with 10" Bottom Hole Assembly (BHA).
    2.2. Strap all tools below the motor.
    2.3. Use water as circulating medium and sweeping hole with calcium carbonate and pre-hydrated gel pills.
    2.4. Catch approximately 10-foot grab samples from drill cuttings and monitor for hydrothermal alteration whenever circulation permits.
    2.5. See attached mud logging (lithologic) procedures.
    2.6. Check returns, if any, for salinity and chlorides.
    2.7. Run maximum reading thermometer (MRT), with surveys, below 500feet.
    2.8. Log temperatures in and out on tour sheets hourly.
    2.9. Continue drilling with water when lost circulation is encountered.
    2.10. Run drilling jars in all assemblies.
    2.11. At +/- 700 feet rig up and bail well until clean water samples are retrieved.
        2.11.1. Notify DLNR 24 hours prior to sampling.
        2.11.2. Collect a representative water sample of ground water at +/- 650 feet.
    2.12. Keep hole straight.

3. Continue drilling 26" hole to +/- 1000 feet. Casing shoe will be set in low permeability rock below major lost circulation zones. The casing will be set if high temperatures or hydrothermal alteration is encountered.

   3.1. Notify PGV Drilling Manager if flow-line temperatures reach or exceed 150 degrees F, or if temperature rise exceeds 10 degrees F/100 feet.
   3.2. Use conventional rotary drilling or mud motors, as appropriate, and water for circulating medium.
   3.3. Use calcium carbonate, loss circulation material (LCM) or high viscosity sweeps to clean well bore as needed.
   3.4. Set cement and polish off plug on bottom if formation is not competent.
   3.5. Continue to monitor for flow or gasses.
   3.6. Conduct BOPE & H2S drills and log on tour sheet.

4. Circulate hole clean and make wiper run with stiff assembly.

   4.1. Circulate hole clean after wiper trip.
   4.2. Measure out of the well bore.
   4.3. Keep hole full, if possible, and check for excess flow.

5. Rig up and run +/- 1000 feet of 22", 0.5", Grade B, Butt Weld casing equipped with float shoe with latch down plug. Centralize casing approximately 10 feet above shoe, on the first collar and every third collar thereafter with "Semi-Rigid" centralizers.

   5.1. Run casing at slow speeds to prevent down surge.
   5.2. Fill casing as required to overcome buoyancy.
   5.3. Have casing sized to remain 3-5 feet off of bottom.
   5.4. Be sure casing is centered prior to cementing.

6. Run in hole with drill pipe and screw into 22" float collar.

   6.1. Circulate hole clean. Reciprocate casing 5-10 feet while circulating to prevent differential sticking if well bore remains full.

7. Cement casing as per cementing program.

   NOTE: If pressure drops off during cement job, pump tail slurry, drop and displace latch down plug and rig up for top job.

   7.1. Monitor returns and surface pressures throughout job.
   7.2. Center casing and wait on cement (WOC).
   7.3. Be prepared to do a top job with High Early (accelerated) Redi Mix. Order out at least 30 yards Redi Mix. Add 50% silica flour to the last load.
   7.4. Have at least 20 cubic yards of sand, gravel and/or volcanic cinders on hand to fill annulus through lost circulation zones if required.
   7.5. WOC a minimum of 12 hours on initial cement job before drilling.

8. Cut off casing and weld on 20" 2000# casing flange.

   8.1. Install pre-fabricated 20" 2000# slip on flange.

8.2. Install prefabricated 22" riser with 20" 2000# flanges and 2 each 6" side outlets with 6" valves and 6" rupture disks or air actuated rubber bladder for diverter lines.

9. Install 20" 2000# annular preventor.

9.1. Notify DLNR 24 hours prior to testing.
9.2. Test BOPE and casing and have DLNR witness and approve test.
9.3. Log test results on tour sheet and morning report. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
9.4. Periodic BOPE drills will be conducted and logged on tour sheets.
9.5. Install and test high efficiency mud cooler. Run coolers, if and as needed.
9.6. All personnel will have BOPE training. Training will be logged on the daily tour report.

10. Make up 20" bit on slick assembly. Clean out cement with mud.

10.1. See Mud Program.

11. Drill 1-5 feet of new 20" hole and circulate clean with mud.

12. Perform leak-off test with 6" valves closed and squeeze if necessary.

13. Install 6" diverter lines. Install H2S abatement equipment on diverter lines.

14. Make up BHA and drill 20" hole to +/- 2200 feet.

14.1. Keep hole straight.
14.2. Survey at approximately 90-foot intervals and run MRT.
14.3. Catch 10-foot grab samples, clean, dry, bag in envelopes and label two complete sets of samples.
14.4. Check mud for increased salinity and chlorides.
14.5. Monitor well for increase or decrease in flow rates and gasses.
14.6. Keep close watch on samples for changes in mineralogy indicative of a high temperature geothermal reservoir.
14.7. Be prepared to set casing if there are any signs of encountering a high temperature reservoir.
14.8. Cement off all lost circulation zones.

15. Run high pump volumes to properly clean hole. See Hydraulics Program.

15.1. Run all solids control equipment. Use course shale shaker screen if necessary to handle volume.
15.2. Keep a close eye on the mud cleaning system, do not let the cuttings tank overflow. Run mud cleaner at all times.
15.3. Keep plastic viscosity and gel strengths as low as possible with at least a 1/32" mud cake and a water loss of 10. (See attached Mud Program)

16. Circulate hole clean and make wiper trip to shoe.

16.1. Measure out of the well bore. Keep hole full at all times.
16.2. Monitor well and be sure well takes proper amount of fluid.
16.3. Check and log any fill on bottom.
16.4. Circulate hole clean and pump sweep.

17. Pull out of the well bore keeping hole full.

18. Rig up and run 16", 97#, L-80, BOSS thread casing equipped with float shoe. Centralize approximately 10 feet above shoe, on first, second third and every third collar thereafter with "Double Bowed" centralizers. Do not use centralizers inside of 22" casing.

18.1. Use thread protectors.
18.2. Run casing at slow speeds to prevent down surge.
18.3. Fill casing with mud while running.
18.4. Continue monitoring the well. Keep hole full.
18.5. Have casing sized to remain off of bottom and to keep collar out of cut off area.

19. Circulate and condition hole for cement. Cement casing using two stages. Do not circulate anything but cement after opening port collar. Do not displace excess cement in annulus with anything but more cement; keep all water and fluids out of annulus.

20. Cement casing as per Cementing Program.

20.1. Monitor returns and pressures throughout job.
20.2. Inflate ECP with cement after bumping plug as per cementing program.

21. WOC at least 12 hours.

22. Cut off casing and install 16" 5000 casing head, using pre-heat and controlled post heat cooling for stress release. Test weld to approximately 2500 psi with nitrogen.

23. Install 16" 5000# mud cross, 16" 5000# double gate, 16" 5000# Banjo Box or Flow Tee or equivalent with rupture disk and remote-operated valve to blooie line. Install 16" 5000# double gate, 16" 5000# annular preventor, rotating head, choke and kill lines, blooie line and muffler. Also, connect water and abatement lines to the blooie line, as shown in the BOPE attachments. Install and check all monitoring equipment. WOC 16 hours prior to testing.

24. Be sure all monitoring equipment is in place including wellhead pressure gauge.

25. Notify DLNR 24 hours prior to BOPE test.

25.1. Log all test results and approvals on tour sheet and morning report.
25.2. All pushers, drillers and derrick men will be trained in the use of monitoring equipment. Training will be logged on the tour sheets.
25.3. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
25.4. Install test plug and test BOPE to approximately 2500 psi below top double gate.

26. Make up 14-¾" bit on a slick BHA to clean out cement and floats.

26.1. Drill 3-5 feet of new hole and circulate clean with mud.
26.2. Perform leak-off test with mud and squeeze if necessary.

27. Drill 14-¾" hole to +/- 5000 feet. Casing point will be in the cap rock above the reservoir as determined by the well site geologist using the criteria described in the "Plan of Operations".

27.1. Run profile nipples in all drilling assemblies.
27.2. Raise the mud weight while drilling to 10.8#/gallon. Below approximately 3200 feet, maintain approximately 2100-psi hydrostatic pressure at the bit or sufficient hydrostatic to prevent flow if required.
27.3. Perform directional drilling in the 14 ¾" hole section. Survey as required with intervals not to exceed approximately 120 feet'. Run MRT with all surveys. See directional program.
27.4. Catch 10-foot grab samples of drill cuttings.
27.5. Keep close watch on all mud properties. Keep pH concentration at about 9. See mud program.
27.6. Monitor well for increase or decrease in flow rates and gasses.
27.7. Keep close watch on samples for changes in mineralogy indicative of a high temperature geothermal reservoir.
27.8. Be prepared to set casing if there are any signs of encountering a high temperature reservoir.
27.9. Observe drill pipe pressure prior to connections. If there is pressure on drill pipe with pump off and no flow at flow line, even with a float in the string, then a steam bubble may be forming in the drill string.
27.10. Cement off all lost circulation zones. If necessary, reduce mud weight.
27.11. Turn on one mud cooler when flow line temperature reaches 150 degrees F. Turn on second mud cooler when flow line temperature again reaches 150 degrees F.
27.12. If well indicates flow or pressure during trips, cool hole with both coolers on and then recheck well for flow.

28. Circulate hole clean and wipe hole to shoe. Strap out.

29. Rig up and run 11-¾", 65#, T-95, SLHC thread casing equipped with Float Shoe, Float Collar 80 feet above shoe, ECP and port collar just inside of 16" casing.

29.1. Use thread protectors. Run casing at slow speed to prevent down surge but fast enough to arrive at bottom prior to major heat build up. Fill casing with mud while running to overcome buoyancy.
29.2. Keep monitoring well. Keep hole full at all times and have casing sized prior to running.
29.3. Centralize casing as follows: approximately 10 feet above shoe, 1st, 2nd, 3rd, and every 4th collar to the 16" shoe. Use positive centralizers inside of the 16" casing, on 1st collar above the ECP and every 3rd collar to the first collar below ground level.
29.4. Size casing so no collar will be in the expansion spool pack off area.
29.5. Centralize casing with casing rams in the lower BOPE and casing head brass set screws.

30. Circulate and condition hole for cement job, monitor flow line temperature and be sure the temperature has dropped off prior to cement job. Conduct cement procedure review with all participants prior to cementing. Cement casing using two stages with NO water between stages. See attached Cement Program and cement accordingly.

31. WOC a minimum of 16 hours.

32. Cut off casing and install expansion spool as directed by expansion spool representative.

    32.1. Use hydraulic torque wrench on all studs attached to the expansion spool.
    32.2. Use Power Plant (Power Piping Code) pattern and tighten all studs to maximum specifications.
    32.3. Seal weld centering ring hold-down studs to eliminate any chance of leakage, after tightening.
    32.4 Test to approximately 3500 psi with nitrogen.

33. Install 12" 1500 Series Master Valve and BOPE (See attached BOPE figure).

    33.1. Use power plant (Power Plant Piping Code) pattern and tighten all studs to maximum specifications when installing Master Valve.
    33.2. Notify DLNR 24 hours prior to testing BOPE.
    33.3. Test casing to approximately 2000 psi or 70% of burst, whichever is less.
    33.4. Install test plug and test BOPE to approximately 3500 psi below top double gate.
    33.5. Test BOPE above top double gate to approximately 2500 psi and annular preventor to approximately 2000 psi.
    33.6. Test to be witnessed and approved by DLNR. Log all test results and approvals on tour sheet and morning report.

34. Clean out casing and drill 1-5 feet of new hole below shoe.

    34.1. Circulate hole clean and cool.
    34.2. Perform leak-off test and squeeze if required. Drilling Manager will provide pressure gradient.

35. Drill 10-5/8 " hole to +/- 9000 feet TVD or until sufficient production is encountered.

    NOTE: 8-5/8", 36#, L-80, SLHC thread casing may be run and cemented with Double lip Liner Hanger if 11-3/4" casing is deemed too shallow or formation is unstable. (See Supplemental Program – following pages.)

36. Continue drilling 10-5/8" hole or (7-7/8" hole if 8-5/8" casing has been set) to TD.

    36.1. Use mud weight that provides approximately 2150 psi hydrostatic head pressure at the casing shoe and maintain mud weight sufficient to provide approximately 2150 hydrostatic while drilling.
    36.2. Take surveys every 120 feet and include MRT.
    36.3. Catch 10-foot grab samples of drill cuttings.
    36.4. Keep close watch on mud properties. Weight up as needed to control well. Keep pH at approximately 9.
    36.5. Be sure all monitoring equipment is in good working order.

36.6. Watch closely for flow or loss and for changes in mineralogy indicative of high temperature geothermal reservoir.
36.7. Run both mud coolers.
36.8. If well indicates flow or shut in pressure during trips, cool hole with circulation and recheck hole parameters.
36.9. Stroke Master Valve from full open to close and function test BOPE on every trip.

37. TD will be Kelly down after total loss circulation occurs or one connection below.

37.1. Place well on kill line at 5-7 barrels per minute and strip out of the well bore to shoe.
37.2. Monitor well while stripping out and maintain vacuum.
37.3. Notify Drilling Supervisor and Drilling Manager immediately.

38. Upon reaching shoe, be sure well is shut in.

38.1. Displace drill string with soapy water.
38.2. Build mud volume to full capacity with proper kill weight mud.
38.3. Kill well with mud and place well on kill line at 5-7 barrels per minute.
38.4. Strip out of the hole and monitor well head pressure closely. Maintain well on vacuum of at least –1 (negative one) psi wellhead pressure.
38.5. Close blind and start pumping water at 8-10 barrels per minute for at least 5 hole volumes. Monitor wellhead pressure (WHP).
38.6. Close Master Valve. Monitor WHP.

39. Lay down drill pipe and tools in mouse hole. Tighten all flanges on wellhead equipment and valves.

40. Tear out BOPE and install second 12" 5000# Master Valve. Install companion flange and swab valve.

41. Install Barton recorder and dial gauge to monitor well pressure.

42. Secure well, rig down and move rig out.

43. Release well to O&M. Note release time on tour sheets.

44. Submit well completion records including: Well record sheet, bit record casing details, pipe measurement records, well schematic diagram, well head assembly diagram and serial numbers of well head valves to Puna Geothermal Venture Office within one week.

Supplemental Program for 8-5/8" Casing

NOTE: If 11-3/4" casing was set earlier than approximately 5000 feet due to hydrothermal alteration or formation was deemed to be unstable, then proceed with the following supplement.

1. Drill 10-5/8" hole from shoe of 11-3/4" casing to +/- 5000 feet following guidelines found in Step 36.

2. Circulate the well clean. Pull out of the well bore to the shoe of the 11-¾" casing and run back to bottom.

   2.1. Circulate the hole clean and cool.
   2.2. Measure drill string while pulling out of the well bore.

3. Rig up and run 8-5/8", 36#, L-80 SLHC thread casing, equipped with float shoe and float collar placed approximately 80 feet above shoe, and Double Slip liner hanger made up on top joint prior to running casing. Casing will be stabilized with Semi Rigid centralizers placed 10 feet above shoe, 1st, 2nd, 3rd and every other collar thereafter.

   3.1. Maintain an approximately 200-foot lap inside of the 11-¾" casing.
   3.2. Use thread protectors and run casing at slow speeds.

4. Tag bottom for redundancy of pipe tally. Circulate to clean and cool well bore.

   4.1. Be sure temperature has dropped at flow line prior to cementing.
   4.2. Reciprocate liner while circulating.

5. Hang 8-5/8" liner 10 feet from bottom and break nut on liner hanger.

   5.1. Cement casing as per attached Cement Program.
   5.2. Unscrew from liner hanger and pull out of hole (POOH).
   5.3. Do not circulate cement out of the hole above liner hanger.
   5.4. WOC

6. Make up 10-5/8" bit on slick assembly and run in hole (RIH). Clean out cement to the top of the Liner Hanger

   6.1. Circulate hole clean and POOH.

7. Make up 7-7/8" bit and clean out Chevron Packing and cement to top of the float collar.

   7.1. Circulate hole clean.
   7.2. Notify DLNR of casing integrity test 24 hours in advance.
   7.3. Pressure test liner lap to 0.9 gradient or as specified by Drilling Manager.
   7.4. Squeeze lap if necessary.

8. Test casing and BOPE and record on tour sheet along with DLNR approval.

9. Drill out cement, Float Collar and Shoe.

10. Drill 7-7/8" hole to TD following the procedures laid out in Step 36 of the Drilling Program.

ATTACHMENT III
PUNA GEOTHERMAL VENTURE
DEVELOPMENT WELL DRILLING PLAN
FOR WELL KS-6

CONDUCTOR CASING AND CELLAR:

A thirty-inch (30") conductor pipe will be set in a 42" hole that was drilled to a depth of 70 feet below ground level or until competent rock is encountered. The conductor is to be cemented in place with concrete placed down the backside of the 30" conductor pipe.

If a cellar is not already in place, then, following the setting of the conductor pipe, dig an earthen cellar and construct a reinforced concrete cellar according to civil contractor's design and specifications (Figure 3-1).

DRILLING - 26" HOLE:

Rig up a suitable drilling rig as shown in Figure 3-2. Weld on 30" pitcher nipple. Spud in with 26" bit. Anticipate losing total returns at any time below surface. Continue drilling ahead on water, aerated mud or foam without returns. Run maximum reading thermometer (MRT) during directional surveys every 90 feet below a depth of approximately 500 feet. Drill to a depth of 700 feet.

At this depth rig up bailer and bail continuously or as required to get a representative ground water sample. Collect samples and send to lab for analysis. Have DLNR witness sampling procedure. Notify DLNR 24 hours prior to taking samples.

Resume drilling 26" hole on water with sweeps as required, aerated mud or foam. Drill to a depth of approximately 1000 feet, the casing point for 22" casing. If abnormal temperatures are encountered, then notify the drilling superintendent and stop drilling. The 22" casing may be set at that point after consulting with and receiving permission from Department of Land and Natural Resources (DLNR).

SURFACE CASING:

Approximately 1000 feet of 22", 0.5" wall, Grade B, butt weld thread casing will be run and cemented in place (Figure 3-3). Run casing while filling on every second joint.

Cement 22" casing through drill pipe with Hawaii cement + 40% silica flour.

Wait on cement for 12 hours. Have at least 200 cubic yards of sand, gravel, and/or volcanic cinders on hand.

Pick up and run 1" tubing down backside of 22" casing. Tag fill. Mix and pump Hawaii cement + 40% silica flour. Circulate to surface. Pull tubing and wash while laying it down. Wait on cement for 12 hours. Should the cement settle, top out with batched ready-mix poured down the backside of the 22" casing. Ready-mix can be accelerated with 2% by weight of calcium chloride. Wait on cement for 12 hours.

BLOWOUT PREVENTION EQUIPMENT (20-inch BOPE) 20" HOLE (Figure 3-4):

Cut off casing and weld on 20" 2000# casing flange and 2 side outlets. Valve the outlets with 3" gate valves.

Blowout prevention equipment to drill a 20" hole shall consist of a 20" 2000# annular preventer and diverter system as shown in Figure 3-4. Test BOPE, per DLNR requirements, and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing.

DRILLING 20" HOLE:

Drill out from underneath the 22" surface casing with mud. Make up a 20" bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent of approximately 10#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Drill out and trip for bottom hole assembly.

Should lost circulation persist, loss interval(s) should be cemented.

The 20" hole is to be drilled to a depth of approximately 2000 feet where 16" casing is to be run.

INTERMEDIATE CASING:

Approximately 2000 feet of 16", 97#, L-80, BOSS thread casing is to be run and cemented in place in a single stage (Figure 3-3).

Cement with Hawaii cement + 40% silica flour. If losses are encountered below the 22" casing shoe, then it may be advisable to cement the 16" string with lightweight cement slurry tailed by 200 sacks of tail slurry. Pump 60% excess. Perform top jobs as necessary.

BLOWOUT PREVENTION EQUIPMENT (16" BOPE) 14-3/4" HOLE (Figure 3-5):

Cut off casing and install 16", 5000# casing head. Blowout prevention equipment to drill a 14-3/4" hole will consist of a mud cross, two 16-3/4" 5000# double gate preventers, a 16-3/4" 5000# annular preventer, a banjo box/flow tee/equivalent with rupture disk and single gate preventer on the side outlet with blind ram inserts, a rotating drilling head, choke, and kill line (Figure 3-5). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment on blooie line (Figure 3-8).

DRILLING 14-3/4" HOLE:

Drill out the shoe with a 14-3/4" bit and slick bottom hole assembly. Perform leak-off test by pressuring well to the equivalent to 11#/gal fluid and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Squeeze if required. Trip for bottom hole assembly. Drill to casing point at approximately 5000 feet.

PRODUCTION CASING:

Approximately 5000 feet of 11-3/4" 65#, T-95, SLHC thread casing is to be run and cemented (Figure 3-3). The casing will have an ECP (External Casing Packer) positioned just above the shoe of the 16" casing. Cement casing with Hawaii cement + 40% silica flour. After WOC, cut off the 11-3/4" casing. Nipple up 16" 5000# x 12" 1500 Series expansion spool with packing sleeve.

BLOWOUT PREVENTION EQUIPMENT (13-5/8" BOPE) 10-5/8" HOLE (Figure 3-6):

Blowout prevention equipment to drill the 10-5/8" section of hole should consist of a 12" 5000# gate valve, 12" 5000# x 13-5/8" 5000# double-stud adapter (DSA), two 13-5/8" 5000# double gate preventers, a 13-5/8" 5000# annular preventer, a banjo box/flow tee/equivalent with a rupture disk and a single-gate preventer on the side outlet, a rotating drilling head, choke, and kill line (Figure 3-6). Test BOPE as per DLNR requirements and note test results in IADC tower report and morning report. Notify appropriate State regulatory agencies 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide abatement equipment and muffler on blooie line and choke line. Provisions will be made to abate any well flow from the choke line or the blooie line.

DRILLING 10-5/8" HOLE:

Drill out from underneath the 11-3/4" casing on water with a 10-5/8" bit and slick bottom hole assembly. Perform leak-off test and note test results on IADC tower report. Squeeze if required. Notify appropriate State agencies 24 hours prior to testing. Trip for packed BHA and continue drilling ahead on mud.

Should differential sticking occur, rig up the air compressor and circulate with air to free the stuck string.

At total depth (TD) circulate out mud with fresh water. Trip-out of hole and rig up flow test. If test is successful, then run perforated liner, if required to keep the hole open.

PRODUCTION LINER (Primary and Alternate Drilling Target):

Production liner will be run only if it is needed to keep hole open. Trip in hole with slick BHA and check for fill. If hole is open, then run approximately 3000 feet of 8-5/8", 36#, L-80, Buttress Thread and Coupling (BTC) casing perforated with round holes. Run liner with cement guide shoe on bottom and hang on a double slip cone type liner hanger (Figure 3-3). Release from hanger and trip out laying down.

Nipple down BOPE and install final wellhead for production well, as shown in Figure 3-7.

ATTACHMENT IV
PUNA GEOTHERMAL VENTURE
DRILLING REPORTING CRITERIA

1. The Drilling Supervisor shall report to the PGV Drilling Engineer/ Manager or his designated relief on the day-to-day operations.

2. As closely as possible, the Drilling Supervisor will follow the drilling program for a particular well as provided by the Drilling Engineer/ Manager. There will be changes in the drilling program as the well progresses, and these changes must be discussed with the Drilling Engineer/ Manager before action is taken.

3. Approximate casing setting depth will be set in the Drilling Program with assistance from the Geologist. These depths should be used absent other information. A mud program will be outlined in the Drilling Program, and this program should be followed as closely as possible. The Drilling Supervisor shall have ample latitude to change the mud program as dictated by the actual drilling conditions.

4. Historical drilling data have been developed regarding the Puna Geothermal Project, and this data should be used to the best advantage in drilling wells within the project.

5. In and out mud temperatures and maximum-recording temperatures will be logged on the IADC tower report.

6. When drilling below the 16" casing shoe, special precautions must be taken when encountering any lost circulation zones or drilling breaks.

7. If a drilling break is encountered while drilling, then the pipe should be picked up to properly place tool joint and bottoms up should be circulated around. The PGV Drilling Supervisor should be immediately notified along with the contractor's supervisor. A temperature survey should be run whenever a drilling break is encountered. The Drilling Engineer/ Manager should make an interpretation of the survey before drilling further. It is important not to drill ahead with excessive temperature in the mud returns.

8. The driller should also note in the IADC tower report any gains or losses in the mud pit volume. Any significant mud loss should be reported to the PGV supervisor(s) and the Contractor's supervisor(s). If any continuous or significant mud gain is encountered, then the driller should pick up the pipe and check for flow and notify the supervisors. If flow is observed, then the well will be shut in immediately.

9. Based on past experience at the Puna Geothermal Project, it is imperative that constant supervision of the well be accomplished once drilling is undertaken below the 16"casing shoe.

10. PGV Supervisors will be in charge of all activities on location. PGV Supervisors will report to the PGV Drilling Engineer or Drilling Manager.

11. Drilling Supervisors will spend sufficient time together at the rig during change-out to exchange information on the current activities. Drilling Supervisors will be on the floor, on the pump truck, in the wireline unit, etc. for all critical operations.

12. The Drilling Engineer/ Manager will be responsible for engineering programs with input from the Drilling Supervisors. The Drilling Engineer/Manager will also advise and assist the Drilling Supervisors.

13. Contractor's supervisors will report to the Drilling Supervisor on location. They will also be on the floor during all crew changes.

14. Reporting procedures for crews will be the responsibility of the drilling contractor. Drillers will log all rig operations on the IADC daily tower report, including the depths of all work performed. Rig crew will assist service company personnel as directed by the contractor's supervisor.

ATTACHMENT V
PUNA GEOTHERMAL VENTURE
PROCEDURES FOR LITHOLOGIC ("MUD") LOGGING

While drilling, depths are recorded on a Bristol chart (a circular chart matching time versus depth). As a single joint is drilled, each ten-foot interval (i.e., 100, 110, 120, etc.) is marked and labeled on the chart. A lag time (the interval of time, measured in minutes, required to circulate drilling fluids from the bit to the surface) is calculated based on hole size and pump rates and a marker is set to indicate when a marked depth reaches the surface.

When drilling fluids containing suspended drill cuttings derived from a given interval reach the surface, such fluids travel down the flow line and over the mesh shaker screens. After the latest ten-foot interval has accumulated at the base of the shakers, the mud logger obtains a representative sample of the drill cuttings. The sample is then washed of the drilling fluid. One portion of the cuttings, the wet sample, is placed in a plastic bag and the remainder is dried and bagged in sample sets.

A small amount is retained to view under a stereomicroscope. The cuttings from each ten-foot interval are then visually and physically evaluated. Detailed written descriptions of each ten-foot interval are entered on work sheets that are subsequently summarized onto the mud log data sheet. The lithologic descriptions include rock type, color, texture, hardness, structural characteristics, alteration (if any) and secondary mineralization.

FIGURE 1

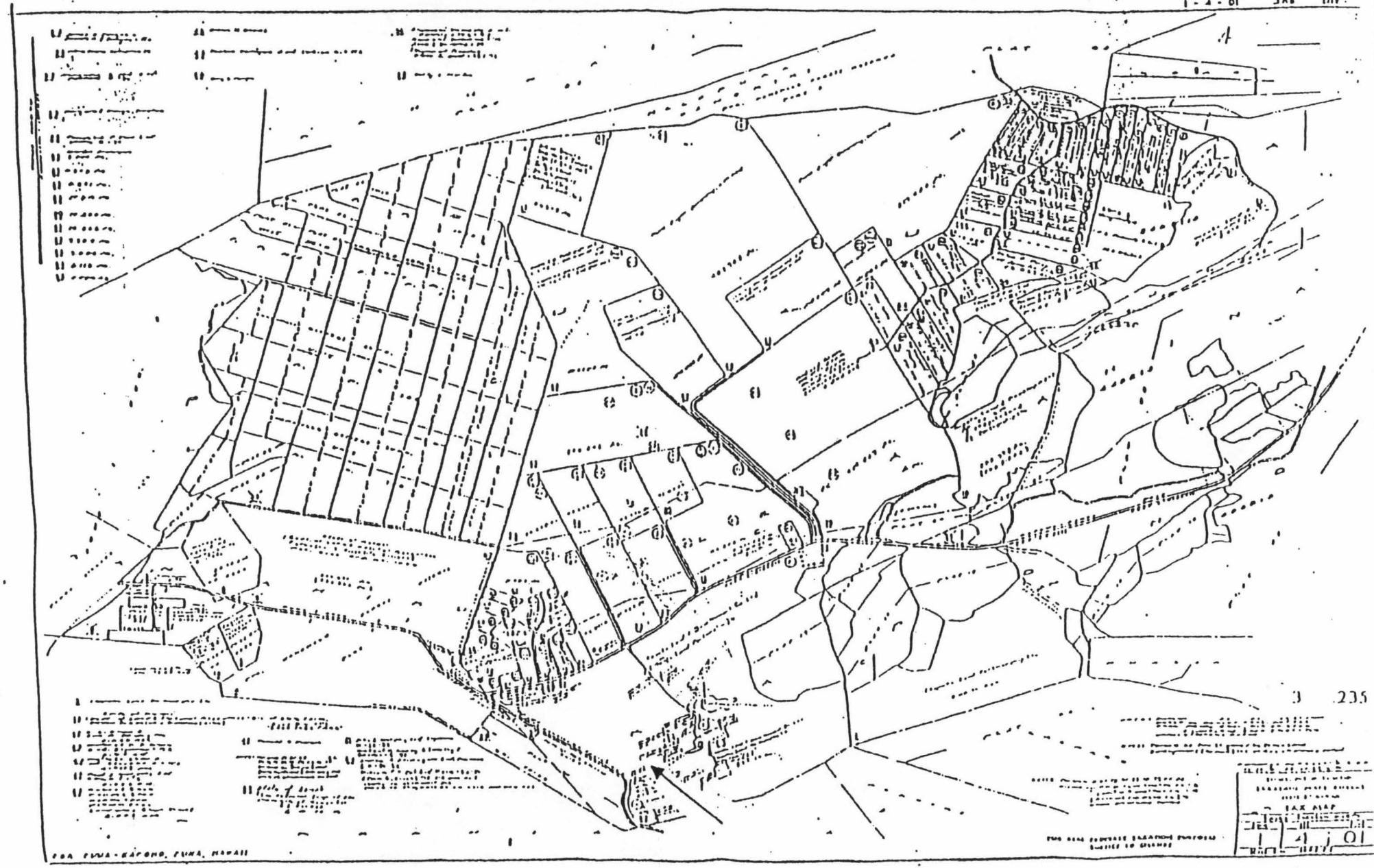
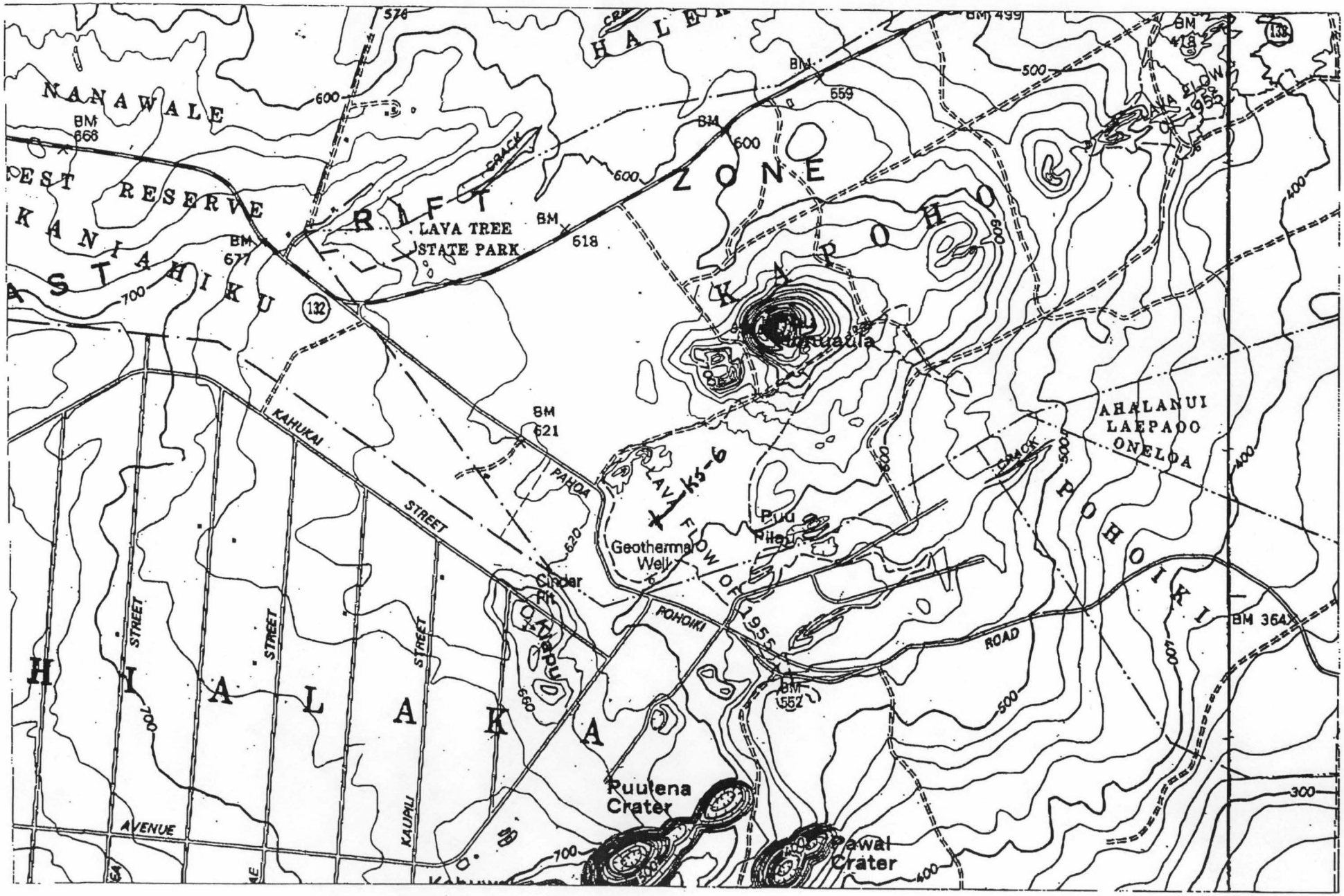


Figure 3


NANAWALE
FOREST RESERVE
KAHIKU
RIFT ZONE
KAPOHO
LAVA TREE STATE PARK
BM 668
BM 677
BM 618
BM 621
BM 559
BM 600
BM 499
BM 364
BM 552
CRACK
1955 FLOW
KAHUKAI STREET
PAHOA
KS-6
LAVA FLOW OF 1955
Geothermal Well
Cinder Pit
Puu Pilau
POHOIKI
ROAD
AHALANUI
LAEPAOO
ONELOA
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STREET
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Puulena Crater
Pawai Crater
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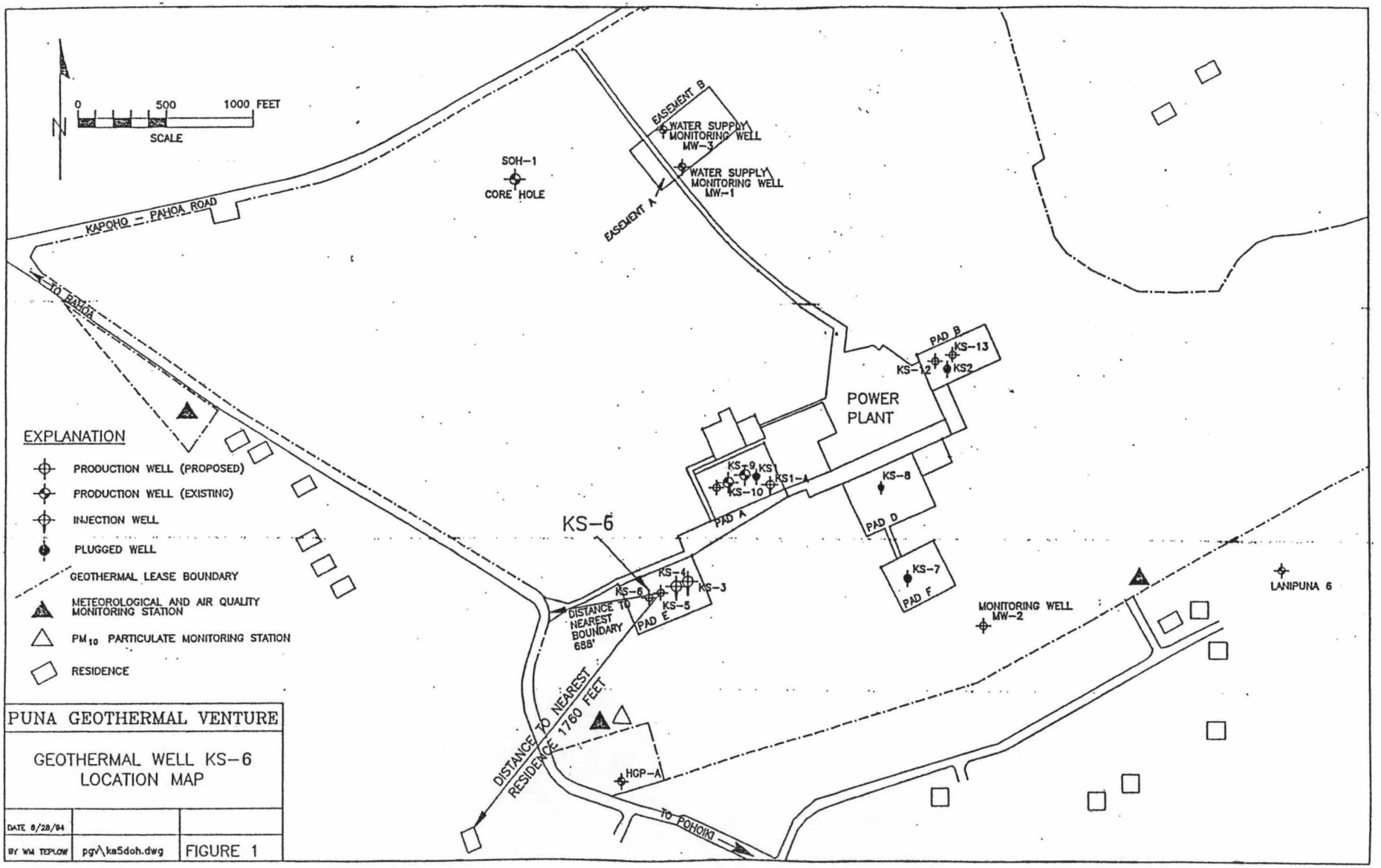
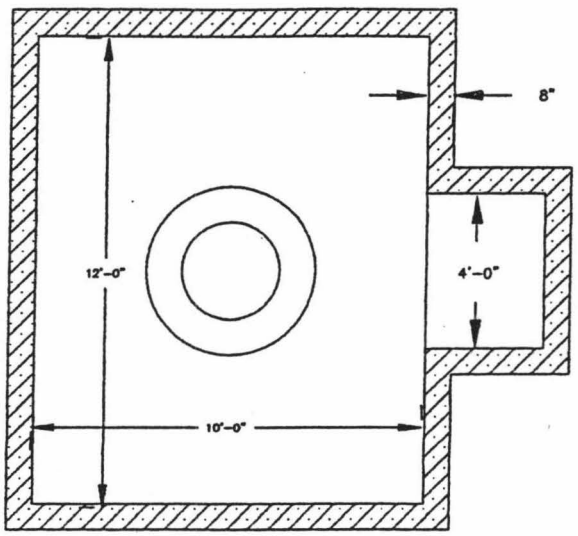
700
600
500
400
300



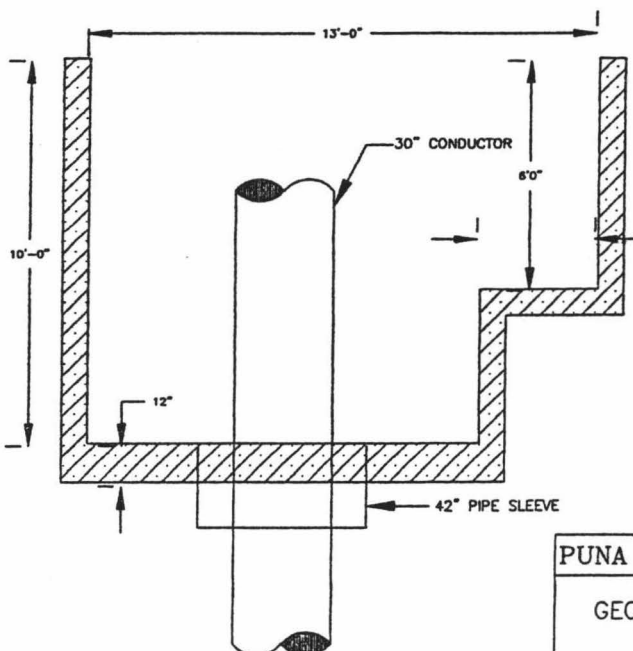
PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL KS-6
LOCATION MAP

DATE 8/28/94		
BY WM TEPLOW	pgv\ka5doh.dwg	FIGURE 1

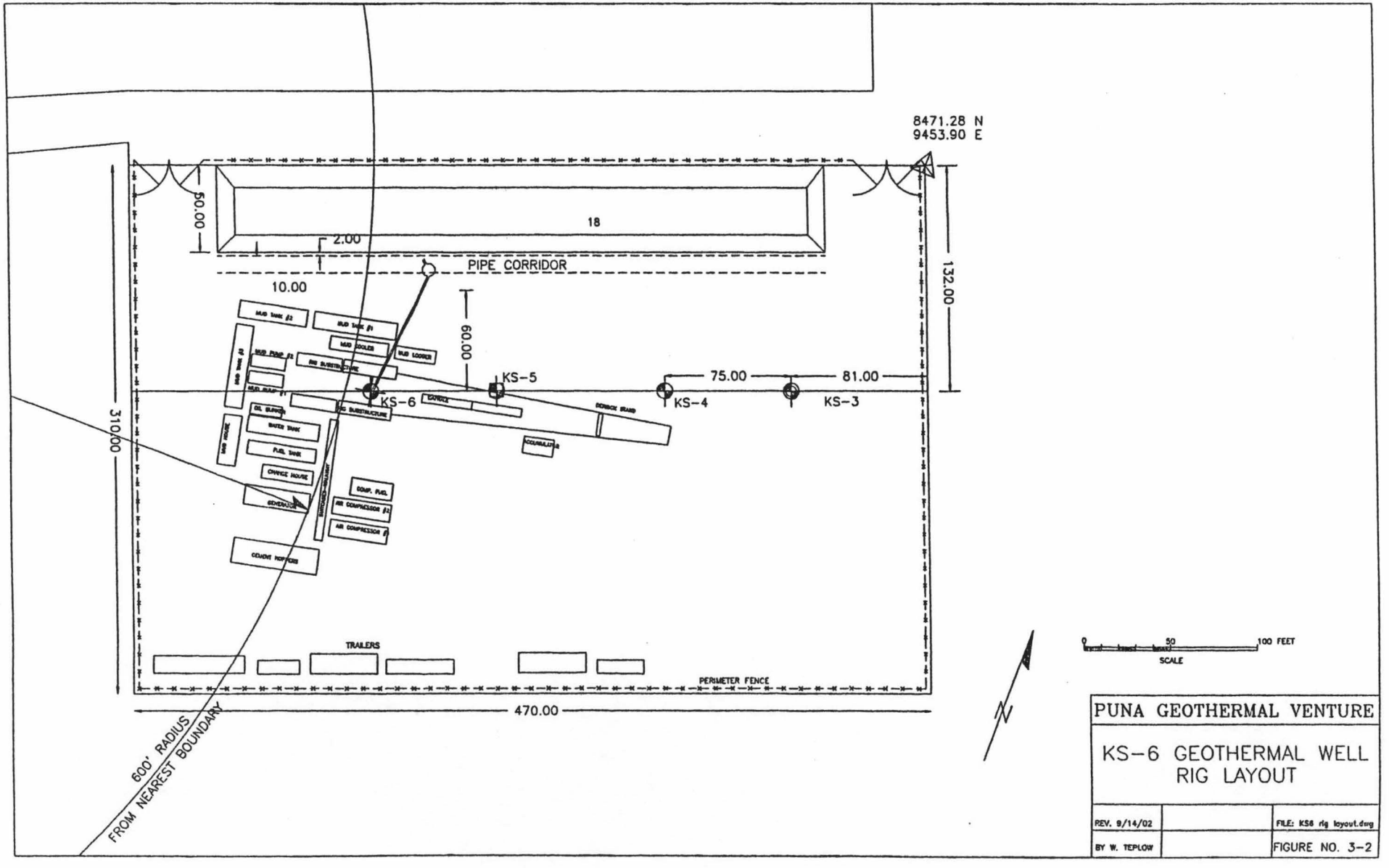


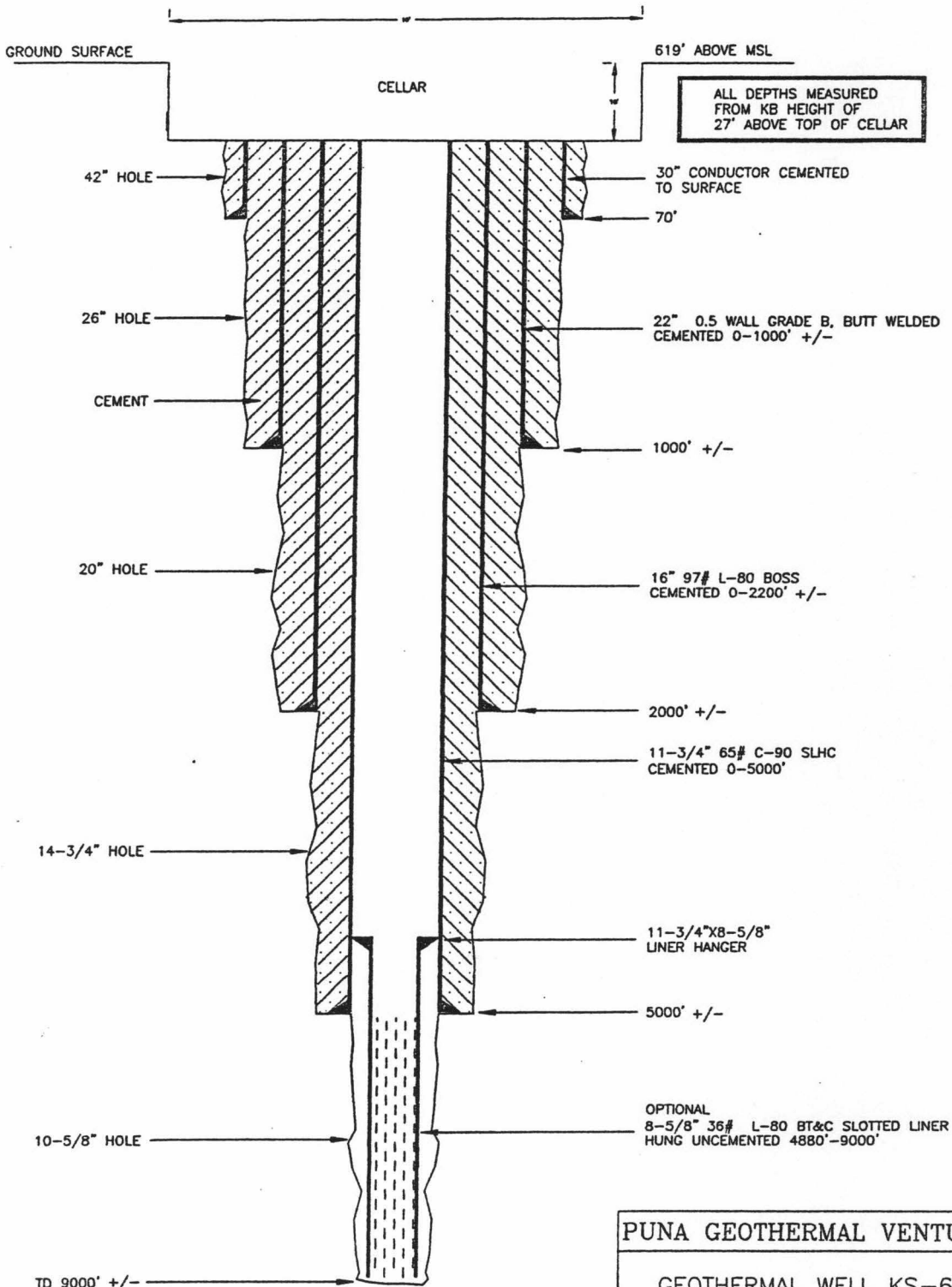
PLAN



VERTICAL SECTION

PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL KS-6 WELL CELLAR		
DATE 9/14/02		file: KS6 cellar.dwg
BY W. TEPLOW		FIGURE NO. 3-1

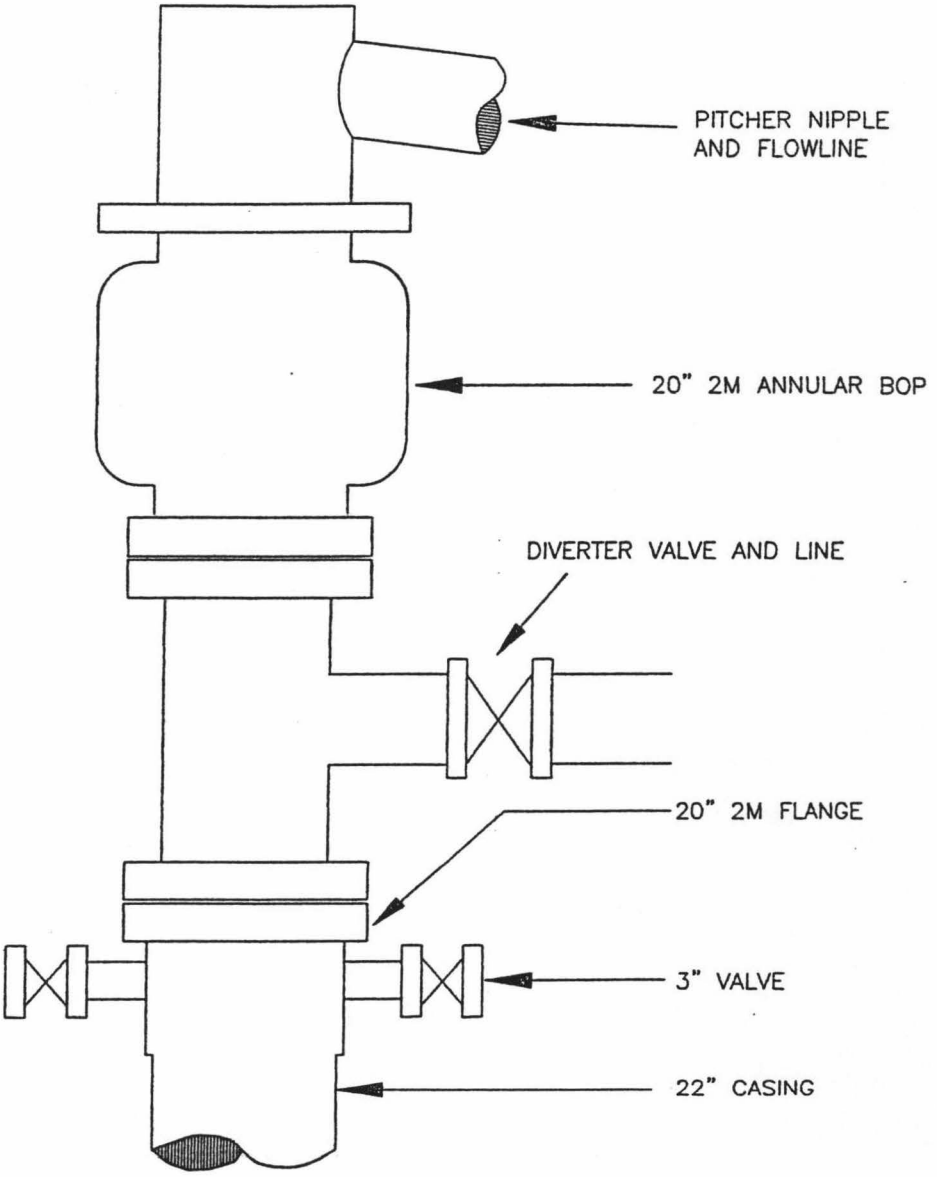

8471.28 N
9453.90 E
50.00
18
2.00
PIPE CORRIDOR
10.00
60.00
132.00
KS-5
KS-6
KS-4
KS-3
75.00
81.00
310.00
TRAILERS
PERIMETER FENCE
470.00
600' RADIUS
FROM NEAREST BOUNDARY
0
50
100 FEET
SCALE
PUNA GEOTHERMAL VENTURE
KS-6 GEOTHERMAL WELL
RIG LAYOUT
REV. 9/14/02
BY W. TEPLOW
FILE: KS6 rig layout.dwg
FIGURE NO. 3-2



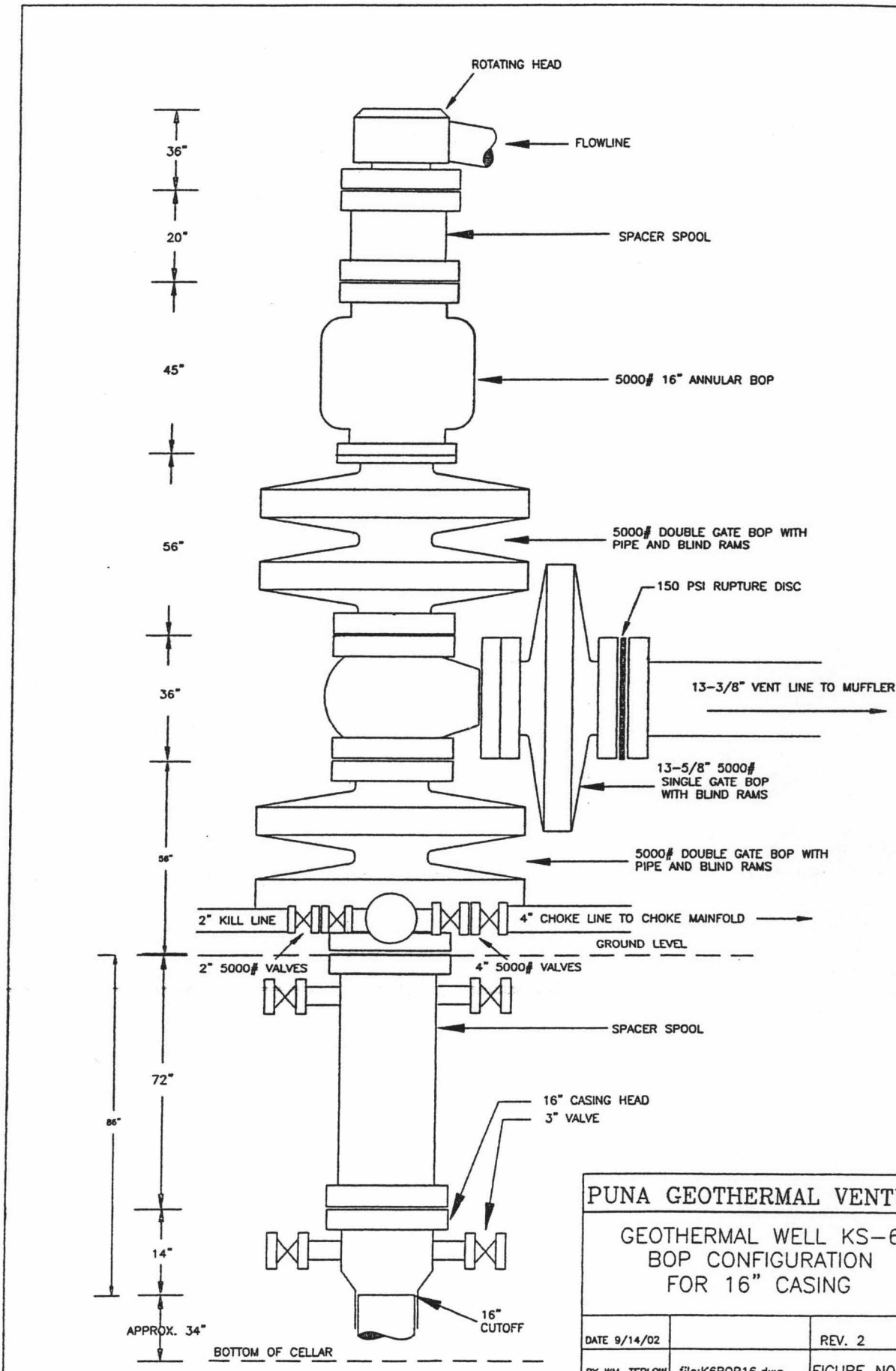
PUNA GEOTHERMAL VENTURE

GEOTHERMAL WELL KS-6
CASING DESIGN

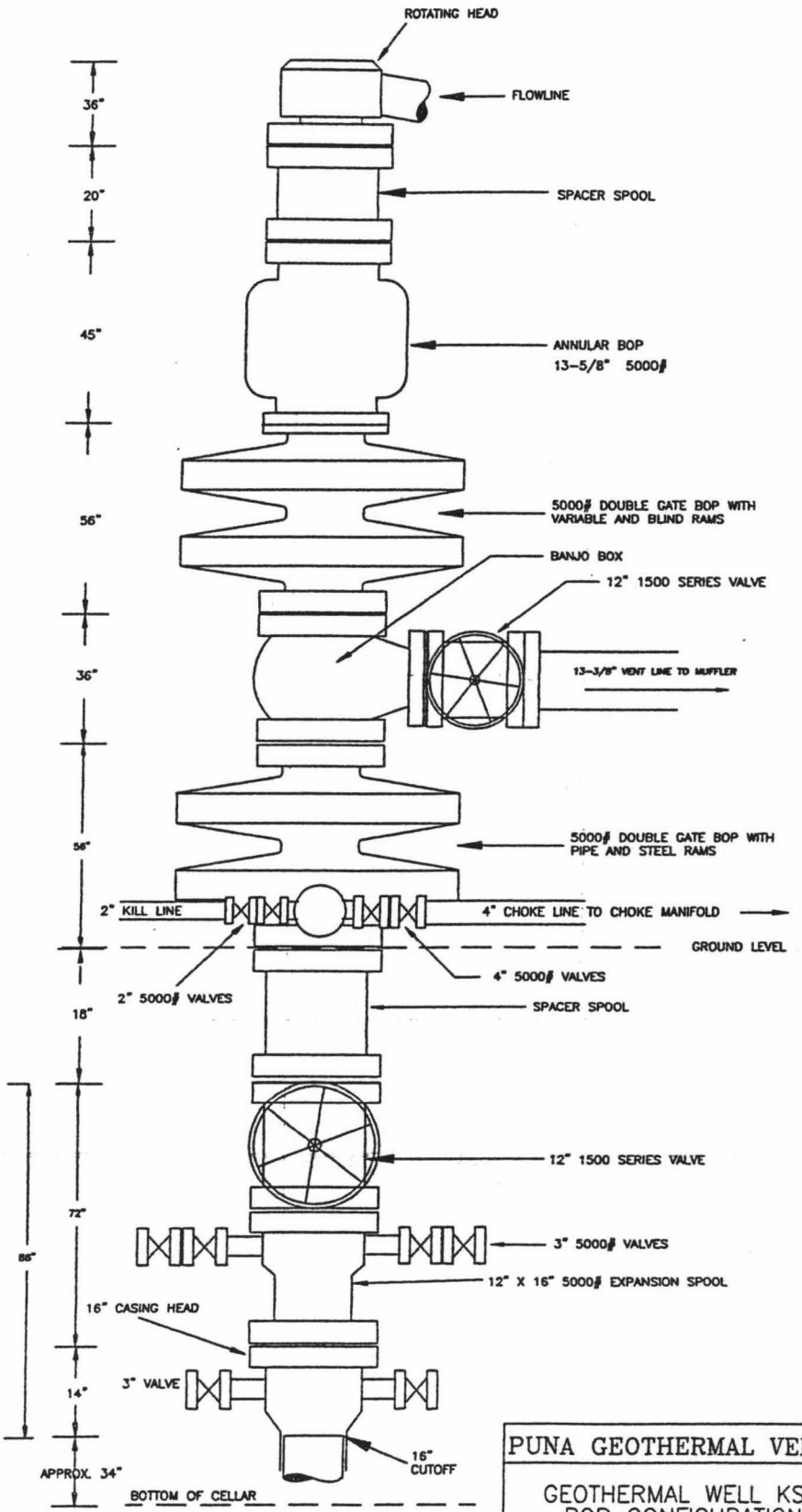
DATE 9/14/02		REV. 2
BY WM. TEPLOW	FILE:PGV\KS6 casing schematic.dwg	FIGURE NO. 3-3



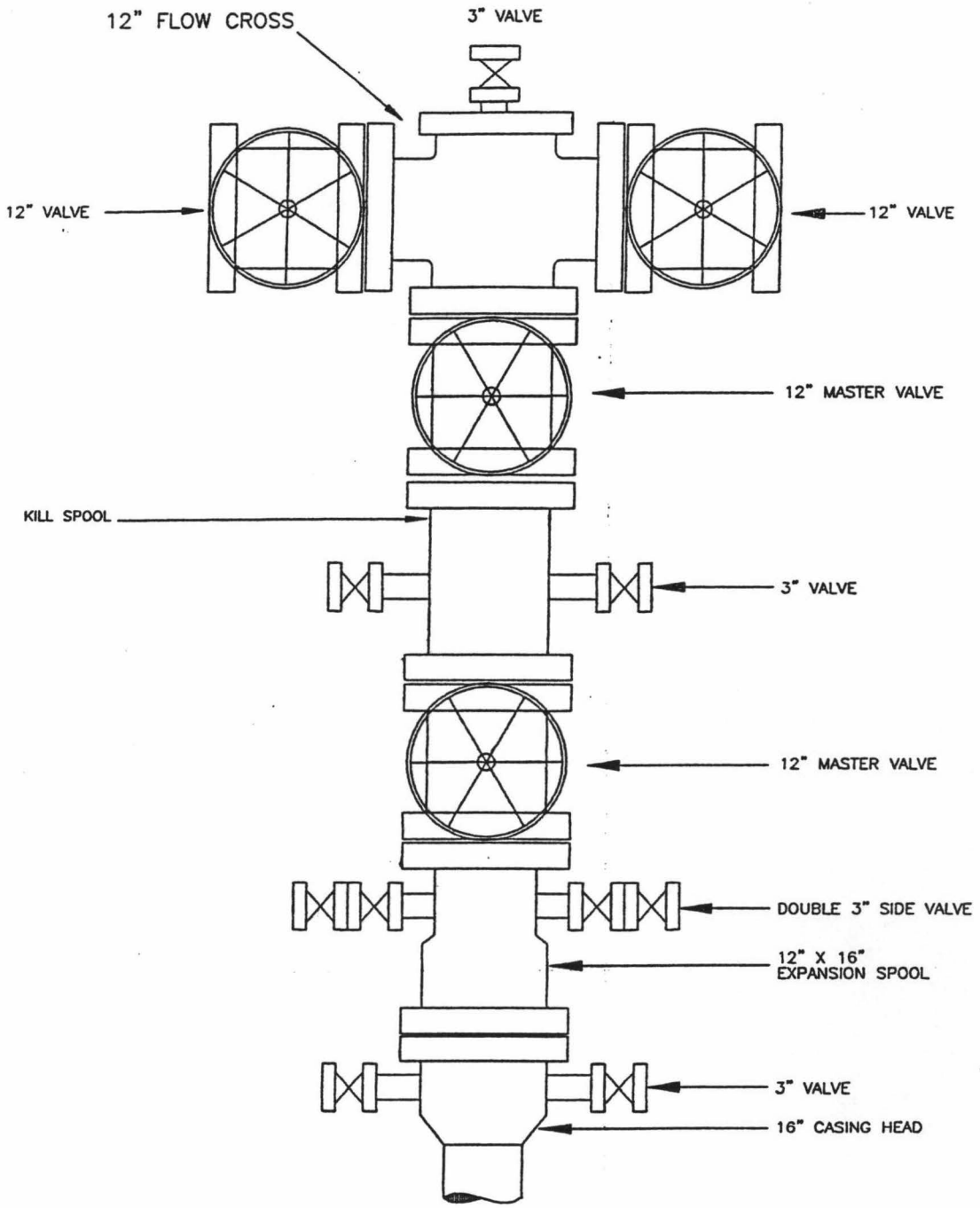
PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL KS-6 22" BOP CONFIGURATION		
DATE 9/14/02		REV. 1
BY WM. TEPLOW	FILE:KS6BOP22.DWG	FIGURE NO. 3-4



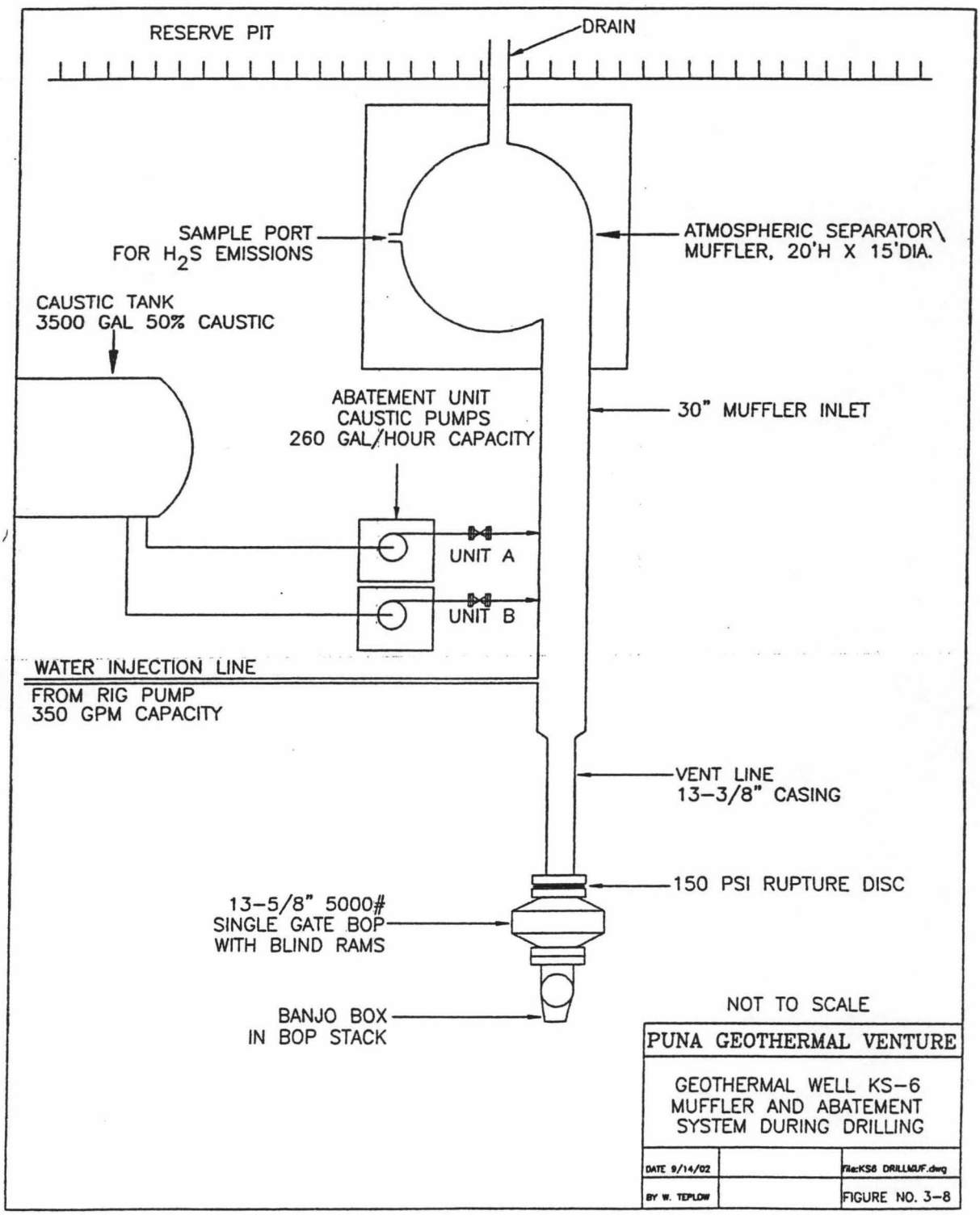
PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL KS-6 BOP CONFIGURATION FOR 16" CASING		
DATE 9/14/02		REV. 2
BY WM. TEPLOW	file:K6BOP16.dwg	FIGURE NO. 3-5



PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELL KS-6 BOP CONFIGURATION FOR 11-3/4" CASING		
DATE 9/14/02		REV. 2
BY WM. TEPLOW	file:ks6bop11.dwg	FIGURE NO. 3-6



PUNA GEOTHERMAL VENTURE		
GEOTHERMAL WELLHEAD CONFIGURATION FOR KS-6		
DATE 9/14/02		REV. 1
BY WM. TEPLOW	FILE:KS6WH.DWG	FIGURE NO. 3-7


RESERVE PIT
DRAIN
SAMPLE PORT
FOR H_2S EMISSIONS
ATMOSPHERIC SEPARATOR\
MUFFLER, 20'H X 15'DIA.
CAUSTIC TANK
3500 GAL 50% CAUSTIC
ABATEMENT UNIT
CAUSTIC PUMPS
260 GAL/HOUR CAPACITY
30" MUFFLER INLET
UNIT A
UNIT B
WATER INJECTION LINE
FROM RIG PUMP
350 GPM CAPACITY
VENT LINE
13-3/8" CASING
150 PSI RUPTURE DISC
13-5/8" 5000#
SINGLE GATE BOP
WITH BLIND RAMS
BANJO BOX
IN BOP STACK
NOT TO SCALE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL KS-6
MUFFLER AND ABATEMENT
SYSTEM DURING DRILLING
DATE 9/14/02
File:KS6 DRILLMUF.dwg
BY W. TEPLOW
FIGURE NO. 3-8

DEPARTMENT OF LAND AND NATURAL RESOURCES

DOCUMENT NO. _____ UAC OR ATTACHED WORKSHEET DATE: **10/31/02**

F	YR	APP	D	SRC/ OBJ	COST CTR	PROJECT	PH	ACT	AMOUNT	NAME/DESCRIPTION (WANG INPUT)
	03	**316**	**C**	**1026**	**0742**				(1) **$100.00**	**Puna Geothermal Venture (PGV)**
									(2)	**BOH #9059 KS-6 Drilling Permit Fee**
									(3)	
									(4)	
									TOTAL **$100.00**	

REMARKS: LINE (1) _____

LINE (2) _____

LINE (3) _____

LINE (4) _____

10/31/02 *0021* CHECK 100.00

DEPARTMENT OF LAND AND NATURAL RESOURCES

DOCUMENT NO. _____ UAC OR ATTACHED WORKSHEET DATE: 5/14/02

F	YR	APP	D	SRC/ OBJ	COST CTR	PROJECT	PH	ACT	AMOUNT	NAME/DESCRIPTION (WANG INPUT)
G	00	00	C	1026	0742				(1) 100.00	PUNA GEOTHERMAL VENTURE BOH #7908
S	02	316							(2)	KS-11 MODIFICATION
									(3)	
									(4)	
									TOTAL $100.00	

REMARKS: LINE (1) _____

LINE (2) _____

LINE (3) _____

LINE (4) _____

05/14/02 *0027* CHECK 100.00

to Diane 5/14

PUNA GEOTHERMAL VENTURE
HAWAII

PUNA GEOTHERMAL VENTURE
[redacted]

BANK OF HAWAII
[redacted]

[redacted]

DATE 5/7/02

PAY One Hundred Dollars and 00/100 DOLLARS $ 100.00

TO THE ORDER OF Department of Land & Natural Resources

[redacted]

MP

[redacted]

DETACH AND RETAIN THIS STATEMENT
THE ATTACHED CHECK IS IN PAYMENT OF ITEMS DESCRIBED BELOW.
IF NOT CORRECT PLEASE NOTIFY US PROMPTLY. NO RECEIPT DESIRED.

PUNA GEOTHERMAL VENTURE

DELUXE - FORM WVCY-3 V-2

DATE	DESCRIPTION	AMOUNT
5/7/02	#7908 - KS-11 Sidetrack - 6150-8500	100.00

V-2

re-start sometime tonight with the request from HELCO to re-start as soon as possible for the grid is short of production. The water well MW-3 was repaired with the replacement of the blown fuses, that was blown due to a glitch in the HELCO grid system.

Eric
----- Forwarded by Andrew M Monden/DLNR/StateHiUS on 11/21/2002 07:56 AM -----

"Engineering Branch Hilo" <hdlog@interpac.net>
11/12/2002 07:44 AM

To: Andrew M Monden/DLNR/StateHiUS@StateHiUS
cc: "Nami J. Wong" <nami_j_wong@exec.state.hi.us>
Subject: Drilling Operations on KS-5 at PGV

Hi Andy:

For your information the drilling operations on KS-5 at PGV continues with the cementing of the 11 3/4" casing. The first stage of the cement job was done yesterday with the return to surface of good cement and the inflation of the packer in the string of casing inflated and set. The drilling personnel are waiting on cement and the arrival of the centering ring for the casing in the wellhead to start the second stage of the cementing of the casing in the well. The second stage will likely take place later this afternoon.

Eric
----- Forwarded by Andrew M Monden/DLNR/StateHiUS on 11/21/2002 07:56 AM -----

"Engineering Branch Hilo" <hdlog@interpac.net>
11/13/2002 06:18 AM

To: Andrew M Monden/DLNR/StateHiUS@StateHiUS
cc:
Subject: Drilling Operations on KS-5 at PGV

Hi Andy:

For your information, the drilling operations on KS-5 continues with the drilling personnel waiting on cement to set up. With the expected temperature in the well, the cement contractor added retarders to the blend, but due to the long period of time of circulating the hole, the temperature in the well was lower than expected. The cement is taking longer to set up than planned.

PGV has announced the tentative date of the well clean-out/flow testing of KS-5 to on or about November 25, 2002.

On Thursday, November 14, 2002, PGV expects the visitation of representatives from the EPA to witness and review the Annual MIT provision of the UIC Permit. Two representatives will be visiting the plant and on Friday a meeting will be held to discuss the operations of the injection wells and the suvey requirements of the permit. On Friday, the representative will also witness the running of the annual MIT Survey of KS-4. A representative of DOH (Chauncey) will also be present at the meeting.

Eric
----- Forwarded by Andrew M Monden/DLNR/StateHiUS on 11/21/2002 07:56 AM -----

"Engineering Branch Hilo" <hdlog@interpac.net>

To: Andrew M Monden/DLNR/StateHiUS@StateHiUS
cc:
Subject: Drilling Operations on KS-5 at PGV

11/14/2002 06:55 AM

Hi Andy:

For your information, the drilling operations on KS-5 continues with the completion of the stage 2 cement job on the 11 3/4" casing job. The job started at 6:00 P.M. and was completed at 7:15 P.M. with good cement returns back to surface and the tool holding pressure preventing bleed back of the cement. The drilling personnel will wait on cement for approx. 8 hours, then start the removal of the 16" BOP stack and the installation of the new expansion spool, the bottom master valve, and the new 13 5/8" BOP stack.

The representatives from EPA will be on site today to start their inspection of records and proceedures for the annual MIT surveys for permit requirements.

Eric

PS: would you please forward on this information to the necessary people.
----- Forwarded by Andrew M Monden/DLNR/StateHiUS on 11/21/2002 07:56 AM -----

"Engineering Branch Hilo" <hdlog@interpac.net>
11/14/2002 04:09 PM

To: Andrew M Monden/DLNR/StateHiUS@StateHiUS
cc:
Subject: Drilling Operations on KS-5 At PGV

Hi Andy:

For your information, the drilling operations on KS-5 at PGV continues with the drilling personnel working on the assembly of the next BOP stack. The 13 5/8" BOP stack and the expansion spool and the bottom master valve will make up the new surface equipment for the next phase of the drilling.

Eric
----- Forwarded by Andrew M Monden/DLNR/StateHiUS on 11/21/2002 07:56 AM -----

"Engineering Branch Hilo" <hdlog@interpac.net>
11/15/2002 05:11 PM

To: Andrew M Monden/DLNR/StateHiUS@StateHiUS
cc:
Subject: Drilling Operations on KS-5 at PGV

Hi Andy:

For your information, the drilling operations on KS-5 at PGV continues with the drilling personnel working on the assembly of the new BOP stack and preparing for the testing of the stack sometime tomorrow morning.

The EPA personnel are on site to witness the logging of the injection well KS-4 for the UIC Permit conditions.

Eric

Nami J Wong

11/04/2002 04:02 PM

To: Eric A Tanaka/DLNR/StateHiUS@StateHiUS
cc: Alyson K Yim/DLNR/StateHiUS@StateHiUS
Subject: Plug and Abandonment of Lanipuna No. 6

Eric,

Please disregard my previous email regarding Lanipuna No. 6. In December 2001, we returned the filing fee to Barnwell with instructions to resubmit the plugging and abandonment application when appropriate.

Nami

Nami J Wong

11/04/2002 03:39 PM

To: Eric A Tanaka/DLNR/StateHiUS@StateHiUS
cc: Alyson K Yim/DLNR/StateHiUS@StateHiUS
Subject: Plug and Abandonment of Lanipuna No. 6

Eric,

Barnwell submitted a request for abandonment of Lanipuna No. 6 in April 2001. We have held their request since PGV performed mechanical integrity testing from November 2001.

Should we process the permit for plugging and abandonment? Thanks.

Nami

Alyson K Yim
10/02/2002 04:08 PM

To: Nami J Wong/DLNR/StateHiUS@StateHiUS
cc:
Subject: Draft Drilling Permit for KS-6

Nami-
Please process when we receive the permit application
Thanks,
Alyson

----- Forwarded by Alyson K Yim/DLNR/StateHiUS on 10/02/2002 04:11 PM -----

"Engineering Branch Hilo" <hdlog@interpac.net>
10/02/2002 04:08 PM

To: "Alyson Yim" <alyson_k_yim@exec.state.hi.us>
cc:
Subject: Draft Drilling Permit for KS-6

Hi Alyson:

Attached is a Draft of the drilling permit for KS-6 that PGV just sent in the mail to Honolulu.

Eric ks-6drillpermit.wp

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
Eric Hirano

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ENFORCEMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 621
HONOLULU, HAWAII 96809

GEOTHERMAL WELL DRILLING PERMIT

Kapoho State No. 6 (KS-6)
Kapoho, Puna Hawaii

TO: Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778-0030
(808) 965-6233

Your application dated September 20, 2002, for a permit to drill a geothermal well on land located withing the Kaphoho Section of the Kilauea Lower East rift Geothermal Resource

Subzone and covered under the State of Hawaii, Geothermal Resource Mining Lease No. R-2 is approved.

Well Designation:	Kapoho State No. 6 (KS-6)
location:	TMK 1-04-01:02
	(Well Pad C)
Well Coordinates:	Latitude154 53' 54" W
	Longitude19 28' 42" N
State Geothermal Mining Lease	R-2
Leased to:	Kapoho Land Partnership
Subleased to:	Puna Geothermal Venture
Operator:	COSI Puna, Inc.
Ground Elevation:	619+/- Above Mean Sea Level
Projected Depth:	8,5000 +/- True Vertical Depth

Approval is granted in accordance with the Department's Administrative rules, Chapter 13-183m HAR, and under the following conditions:

(1) All work shall be performed in accordance with the permission and terms of the occupiers of the land, the Drilling and Completion Program submitted with your application, the Department's Administrative Rules (Chapter 13-183 and 13-184, HAR), and all other applicable Federal, State, and County Laws, ordinances, rules and regulations;

(2) The permittee, its successors and assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury and death arising out of any act or omission of the applicant, assigns, officers, employees, contractors and agents under this permit or relating to or connected with the granting of this permit;

(3) The permittee shall observe and comply with all valid requirements of County, State, and Federal authorities and regulations to the land and permittee's's operations including, but not limited to, all water and air pollution control laws and those relating to the environment;

(4) The well and bottom-hole location shall be located more than 100 feet from the outer boundary of the parcel of land on which the well is situated, or more than 100feet from a public road, street or highway dedicated prior to the commencement of drilling, unless modified by the Chairperson upon request;

(5) The permittee shall notify the Department of Land and Natural Resources, in writing, of the date of the start of the drilling operations;

(6) Prior to drilling, the permittee shall submit to the Department the bottom-hole target location and the direction of any proposed deviation;

(7) All Blow-Out Prevention Equipment (BOPE) and cemented casing strings shall be pressure tested before commencing any other operations on the well. The minimum test pressures shall be approximately on-third of the casing internal yield pressure rating, providing the test pressure shall not be less than 600 psig nor greater than 2500 psig, and shall be applied for a period of thirty minutes. The results of the pressure tests shall be reported on forms provided by the Department;

(8) Class "G" cement shall be used in the casing cementing operations and shall contain a high temperature resistant admix;

(9) A real time monitoring device shall be installed for the driller and a pit alarm system shall be included with this monitoring device. All toolpushers, drillers, and derrickment shall be schooled in the use of the recommended monitoring equipment;

(10) If changes to the proposed drilling programs are contemplated, the permittee shall obtain the Chairperson's approval before executing such changes;

(11) When drilling has reached a depth of not more than 50 feet below sea level, the Department's representative shall be notified, with reasonable time allowed for travel to the site, to witness the retrieval of a representative ground water sample and the

measurement of the static water level. The permittee shall have the sample analyzed by

an independent laboratory and have the results submitted to the Department;

(12) A pressure and temperature survey, to inspect the mechanical integrity of the well, shall be performed after the well has been drilled to total depth, and before commencing the well cleanout flow or injection test;

(13)(12) During the used of the well for testing, monitoring, production and/or injection purposed, the well and site shall be properly maintained until the well is plugged and abandoned in accordance with the Department's Administrative Rules, Chapter 13-183, HAR;

(14) The permittee shall submit to the Chairperson, the results of any exploration, all drilling and testing records, down-hole surveys of the well, bottom-hole location, date of completion, and a survey of the well location and elevation above mean sea level taken by a Hawaii licenced surveyor within six months after completion of the well;

(15) A well completion report, an as-built drawing of the well, and the location of the well plotted on a U.S.G.S. quad map shall be filed with the Department within six months after completion of the well;

(16) The bond covering the well shall remain in full force and effect until the well is properly abandoned and the surface is restored as near as possible to its original condition; and

(17) This permit shall expire 365 days from the date of issuance.

_____

Gilbert Coloma-Agaran, Chairperson
Department of Land and Natural Resources

_____

Date of Issuance

C: Land Board Members
Hawaii County Planning Dept.
DBEDT
Department of Health
QEQC

Nami J Wong

12/11/2001 11:10 AM

To: Andrew M Monden/DLNR/StateHiUS@StateHiUS, Alyson K Yim/DLNR/StateHiUS@StateHiUS, Dean A Nakano@STATEHIUS, Keith K Chun/DLNR/StateHiUS@StateHiUS

cc:

Subject: NELHA RFP

Tom Daniels indicated that the NELHA board will consider the RFP evaluation committee's recommendations next Tuesday, December 18. A press release will be issued shortly thereafter.

Date: 9/5/2001
Sender: Alyson K Yim
To: Nami JH Wong, Dean A Nakano
Priority: Normal
Receipt requested
Subject: Fwd:Annual Plant Shut Down at PGV

fyi.
Eric said he was on-site for 26 hours (!?!). He went home after sending this report.

_____Forward Header_____

Subject: Annual Plant Shut Down at PGV
Author: "Engineering Branch Hilo" <hdlog@interpac.net>
Date: 9/5/2001 7:53 AM

Hi Andy:

Attached are two memo regarding the work at PGV for the annual plant shut down.

Eric


2001plantshut down1.wpd


ks-9workov95.wpd

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
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DEPARTMENT OF LAND AND NATURAL RESOURCES
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ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

September 5, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Annual Plant Shut Down at Puna Geothermal Ventures

For your information, during the annual plant shut down at Puna Geothermal Ventures, the following operations are being scheduled:

1. KS-9 work-over to change out the wellhead equipment (started)
2. KS-11 work to remove debris from the wellhead assembly.
3. Annual MIT Surveys for the injection well as a permit condition for the UIC Program under EPA and DOH
4. Annual repair and maintenance work for the power plant
5. The reconfiguration of the steam piping system to re-connect the new separator into the steam system to the power plant

If there any questions to any of the above, please feel free to call on me at any time.

Mahalo,

Date: 5/30/2001
Sender: Alyson K Yim
To: Nami JH Wong, Dean A Nakano
Priority: Normal
Receipt requested
Subject: Fwd:PGV request for approval to conduct a tracer test

FYI

_____Forward Header_____

Subject: PGV request for approval to conduct a tracer test
Author: "Engineering Branch Hilo" <hdlog@interpac.net>
Date: 5/30/2001 3:59 PM

Hi Andy:

Attached is a memo on PGV's request for approval to run a tracer test in KS-10.

Eric

tracer2001.wpd

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
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P.O. BOX 373
HONOLULU, HAWAII 96809

May 30, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: PGV requests from EPA and DOH to conduct a tracer test in KS-10

Puna Geothermal Ventures have formally requested approval from both the Environmental Protection Agency, Ground Water Office and The Department of Health, Underground Injection Program, to conduct a tracer test utilizing KS-10 to inject a Salt Solution (Maphthalenedisulfonic Acid Sodium Salt) down the wellbore. KS-9 will be monitored to check for the return of the tracer chemical. The chemical is similar to the chemical that was used in the previous tracer test conducted in 1998. The tracer test will verify if there is any communications between KS-10 and KS-9. The flow from KS-11 will also be monitored if the trace chemical does show up in the flow from the well. The tracer test will also give more information about the reservoir.

Due to the type of chemical being utilized for the tracer test, I have no concerns in the conducting of the tracer test. It will also verify more information about the reservoir and how it will effect the reservoir model.

Hard copies of the approval request will be forwarded on to you.

If there are any questions to any of the above, please feel free to call on me at any time.

Mahalo,

Date: 3/23/2001
Sender: Alyson K Yim
To: Nami JH Wong, Dean A Nakano
Priority: Normal
Receipt requested
Subject: Fwd:Work-Over of KS-1A at PGV

fyi

_____Forward Header_____

Subject: Work-Over of KS-1A at PGV
Author: "Engineering Branch Hilo" <hdlog@interpac.net>
Date: 3/23/2001 3:38 PM

Hi Andy:

Attached is a memo on the 4th day of the work-over on KS-1A at PGV and also the completion of the project.

Eric

ks-1awo4thday.wpd

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

March 23, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Work-Over Work on Injection Well KS-1A at Puna Geothermal Ventures

As of 7:00 A.M. this morning, after checking the nitrogen pressure gauge on the annulus of the 5" hang-down liner in KS-1A, the drilling rig was released from the job. The nitrogen pressure gauge read 1000 psi. the same as of 9:00 P.M. last night went the pumping of nitrogen into the annulus of the 5" was secured. Over night the hang-down liner held the nitrogen gas with no leaks at all. The job is a success and the pressure is rock solid. After the rig is rigged down and mobilized off the well, the wellfied personnel will re-install the reinjection line and conduct a 5 hour test of the nitrogen pressure. With no loss of pressure, the EPA has given approval for the well to be returned back to service. The production personnel will resume the injection of brine into the well.

On Monday, March 26, 2001, a representative from the Environmental Protection Agency San Francisco Office will be visiting the Plant to inspect on the work-over project and take a look at the nitrogen gas blanket in the annulus of the 5" hang-down liner. This is an announced visit in accords with the notification to EPA of the project of replacing the liner in the Injection Well.

If there are any questions to any of the above, please feel free to call on me at any time.

Mahalo,

Date: 3/6/2001
Sender: Alyson K Yim
To: Nami JH Wong, Dean A Nakano
Priority: Normal
Receipt requested
Subject: Fwd:Change in schedule for KS-1A hang down liner changeout

fyi

_____Forward Header_____

Subject: Change in schedule for KS-1A hang down liner changeout
Author: "Engineering Branch Hilo" <hdlog@interpac.net>
Date: 3/6/2001 3:40 PM

Hi Andy:

Attached is a memo on the change in the schedule for the change out of the hang down line in KS-1A and also the scheduling of the capacity flow testing of KS-11 with the used of KS-1A with the permission from EPA and DOH.

Eric

ks-1achangeout2.wpd

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
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P.O. BOX 373
HONOLULU, HAWAII 96809

March 6, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Hang-Down Liner Change Out on KS-1A and Utilization of the Well for injecting fluid during testing of KS-11 Production Well at Puna Geothermal Ventures

The schedule for the change out of the hang-down liner in Injection Well KS-1A at Puna Geothermal Ventures has been changed and more than likely to start on or around March 21, 2001. The reason for the change is the non-arrival of the handling tools from the mainland to do the job. The tools are scheduled to arrive in Hilo on 3-19-01.

With the change in the schedule to do the change out of the hang down liner, the testing of the flow capacity of the Production Well KS-11 is being scheduled. With the permission from EPA and DOH to use KS-1A for injecting fluid for a period of two weeks, KS-11 will be opened up to flow at a higher capacity to a level that the plant can handle the total amount of fluids that the well will be making during the flowing of the well at higher capacity. Tests will be run and samples of the fluid will be taken during the flowing of the well at the higher capacity. The test will be for the deliver ability of the KS-11 and also the entropy of the well.

If there are any questions to any of the above, please feel free to call on me at any time.

Mahalo,

Date: 2/20/2001
Sender: Alyson K Yim
To: Nami JH Wong, Dean A Nakano
Priority: Normal
Receipt requested
Subject: Fwd:Shut in of Injection Well KS-1A at PGV

fyi

_____Forward Header_____

Subject: Shut in of Injection Well KS-1A at PGV
Author: "Engineering Branch Hilo" <hdlog@interpac.net>
Date: 2/20/2001 3:42 PM

Hi Andy:

Attached is a memo on the shut in of Injection Well KS-1A at Puna Geothermal Ventures.

Eric

ks-1ashutin22001.
wpd

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
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DEPARTMENT OF LAND AND NATURAL RESOURCES
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ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

February 20, 2001

To: Andrew Monden, Chief Engineer
Engineering Section, Honolulu

From: Eric Tanaka
Engineering Section, Hilo

Re: Injection Well KS-1A at Puna Geothermal Ventures

For your information, the Injection Well KS-1A was shut in due to the leak off rate of the nitrogen pressure blanket on the backside of the hang down line became greater than the conditions of the UIC Permit. Both the DOH and the EPA were notified of the shut in of the well and the conditions that lead up to the shut in. Plans are being made for the operations to change out of the hang down line with a new string of pipe.

The wellfield personnel also did some testing of the well to see if the leak in the liner could be repaired without removing the liner. The nitrogen pressure was brought up in small increments to locate the hole. At 300 psi. the pressure in the wellbore and the annulus equalized, indicating the hole very high in the hang down liner string. The only repair to be done would be the change out of the liner string. In the period before the operation to change out the liner, nitrogen will be kept in the well to protect the casing. As of 12:20 P.M. today, the pressure at 905 psi.

If there are any questions to any of the above, please feel free to call on me at any time.

Mahalo,
Eric

Date: 1/22/2001
Sender: Andrew M Monden
To: Alyson K Yim, Nami JH Wong
Priority: Normal
Subject: Fwd:PGV

_____Forward Header_____

Subject: PGV
Author: "Engineering Branch Hilo" <hdlog@interpac.net>
Date: 1/22/01 3:44 PM

Hi Andy:

Attached is a memo concerning PGV.

Eric
(See attached file: pgvgrpleak.wpd)

pgvgrpleak.wpd

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
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DEPARTMENT OF LAND AND NATURAL RESOURCES
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P.O. BOX 373
HONOLULU, HAWAII 96809

January 22, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Puna Geothermal Ventures

During the pass couple of days, the following has transpired for Puna Geothermal Ventures.

1. On Friday, January 19, 2001, the County Planning Commission approved the requested revised County Geothermal Permit at their monthly commission meeting. After a public hearing the commission voted 6-0 to approve the GRP. During the mediation period, a few items were agreed by the group, but there were items that were not agreed by the whole group. The commission heard comments on the items and made decisions on these items. I will be passing on the new GRP when it is published.

2. On Saturday, there was a leak in the reinjection line that caused the power plant to go all the way down. There were no alarms at the stationary monitoring stations at the perimeter of the development. The plant personnel worked on the items that needed repairs and restarted the plant. During the restart of the plant, the operating pressure on the plant (LSP) was higher that the wellhead pressure of KS-10. The higher pressure (LSP) over came the pressure in KS-10 and killed the well. The plant personnel are bleeding KS-10 to Injection Well KS-1A to build pressure and raise the temperature in the Well at this time. Plans are to build the pressure in KS-10 before trying to bring the well back on line to the plant. The plant is running 9 units at this time, for it is more efficient that running 10 units.

If there are any questions to any of the above, please feel free to call on me at any time.

Notification To Our Neighbors

December 30, 2002

PUNA GEOTHERMAL VENTURE
HAWAII

PUBLIC NOTIFICATION OF CLEAN-OUT OPERATIONS OF KAPOHO STATE 5 (KS-5)

We were unable to clean out the well as scheduled last week and appreciate your patience and understanding.

As required by permit and our commitment to keeping our immediate neighbors informed, Puna Geothermal Venture (PGV) hereby gives notice of plans to commence abated well clean-out operations for the new geothermal production well, Kapoho State 5 (KS-5) on or about January 2, 2003, or shortly thereafter.

Should you have any questions, please feel free to call the numbers listed below.

PGV Information Line – 934-9072	For information concerning the daily status and operation of the plant.
PGV's Response Line – 965-8843	A company representative will return your call.

From all of us at PGV, we wish you a Happy New Year!

40786

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

GDS

December 11, 2002

Mr. Wilfred Nagamine, Chief
Clean Air Branch
Environmental Management Division
Hawaii Department of Health
P.O. Box 3378
Honolulu, HI 96801

SUBJECT: 48-HOUR NOTIFICATION OF THE COMMENCEMENT OF FLOW TESTING KAPOHO STATE 5 (KS-5) PRODUCTION WELL

Dear Mr. Nagamine:

In accordance with the Noncovered Source Permit (NSP) No. 0008-02-N, Attachment IIB, Section D.2, Puna Geothermal Venture (PGV) hereby notifies the Hawaii State Department of Health that PGV will commence the Flow Testing of production well Kapoho State 5 (KS-5) on or around December 18, 2002, or shortly thereafter. This is an update to previous notifications.

If you need any additional information, please do not hesitate to contact me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

cc: Nolan Hirai, HDOH
Ed Yamamoto, HDOH
Gilbert Coloma-Agaran, DLNR
Eric Tanaka, DLNR
M. Kaleikini / B. Wiebe, PGV

T:\BTM\CORRES.OUT\DOH\KS-5\021211flo48hrnot.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

December 2, 2002

Mr. Wilfred Nagamine, Chief
Clean Air Branch
Environmental Management Division
Hawaii Department of Health
P.O. Box 3378
Honolulu, HI 96801

SUBJECT: NOTIFICATION OF THE FLOW TESTING KAPOHO STATE 5 (KS-5)

Dear Mr. Nagamine:

'02 DEC 05 AM 10:16 WATER & LAND

In accordance with the Noncovered Source Permit (NSP) No. 0008-02-N, Attachment IIB, Section D.2, Puna Geothermal Venture (PGV) hereby notifies the Hawaii State Department of Health that PGV completed the first day of flow testing of production well Kapoho State 5 (KS-5), on Friday, November 29, 2002.

This is an update to previous notifications. KS-5 was flowed for 3 hours and 50 minutes. During the flow testing it became evident that the well was lacking the steam flow needed to operate PGV's system. The current plan is to drill an additional 100 ft. and flow test again once the new depth is reached.

If you need any additional information, please do not hesitate to contact me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

cc: Nolan Hirai, HDOH
Ed Yamamoto, HDOH
M. Kaleikini / B. Wiebe, PGV
Gilbert Coloma-Agaran, DLNR
Eric Tanaka, DLNR

T:\BTM\CORRES.OUT\DOH\KS-5\021202flo48hrnot.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4

43694

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

December 2, 2002

Mr. Wilfred Nagamine, Chief
Clean Air Branch
Environmental Management Division
Hawaii Department of Health
P.O. Box 3378
Honolulu, HI 96801

'02 DEC 04 AM 11:31 WATER & LAND

SUBJECT: NOTIFICATION OF THE FLOW TESTING KAPOHO STATE 5 (KS-5)

Dear Mr. Nagamine:

In accordance with the Noncovered Source Permit (NSP) No. 0008-02-N, Attachment IIB, Section D.2, Puna Geothermal Venture (PGV) hereby notifies the Hawaii State Department of Health that PGV completed the first day of flow testing of production well Kapoho State 5 (KS-5), on Friday, November 29, 2002.

This is an update to previous notifications. KS-5 was flowed for 3 hours and 50 minutes. During the flow testing it became evident that the well was lacking the steam flow needed to operate PGV's system. The current plan is to drill an additional 100 ft. and flow test again once the new depth is reached.

If you need any additional information, please do not hesitate to contact me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

cc: Nolan Hirai, HDOH
Ed Yamamoto, HDOH
M. Kaleikini / B. Wiebe, PGV
Gilbert Coloma-Agaran, DLNR
Eric Tanaka, DLNR

T:\BTM\CORRES.OUT\DOH\KS-5\021202flo48hrnot.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

November 25, 2002

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

SUBJECT: KAPOHO STATE NO. 5 (KS-5) BLOW OUT PREVENTION EQUIPMENT (BOPE) PRESSURE TEST

Dear Mr. Coloma-Agaran:

Puna Geothermal Venture (PGV) hereby submits the following information concerning the BOPE pressure test, casing pressure test, and formation pressure test on the 13.625" equipment.

Should you have any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

Enclosures: DLNR BOPE Pressure Test
Casing Pressure Test
Cement Plug Pressure Test

cc: M. Kaleikini/B. Wiebe, PGV
E. Tanaka, DLNR

T:\BTM\CORRES.OUT\DLNR\KS-5\021122psitestdata.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

STATE OF HAWAII
Department of Land and Natural Resources
Land Division
Engineering Branch

BOPE PRESSURE TEST

Instructions: Please print or type and send completed form with any attachments to Land Division, Engineering Branch, P.O. Box 373, Honolulu, Hawaii 96809

Reference DLNR Regulations:
Section 13-183-76 (b) All casing strings shall be pressure tested after cementing and before commencing any other operations on the well. Minimum casing test pressure shall be approximately one-third of the manufacture's rated internal yield pressure; provided that the test pressure shall not be less than six hundred pounds per square inch and greater than 1500 pounds per square inch. In cases where combination strings are involved, the above test pressures shall apply to the lowest pressure-rated casing used. Test pressures shall be applied for a period of thirty minutes. If a drop of more than ten percent of the test pressure should occur, the casing or cement job shall be considered defective and corrective measures shall be taken before commencing any further operations on the well.

Casing Pressure Test:

1. Project Name PUNA RESOURCE RECOVERY PROJECT
2. Drilling Company TRUE
3. Well name and number VS-5
4. Location PUNA SITE
5. Person(s) taking test CLIFFORD SHEEHAN
6. Date of test 11/16/02
7. Time of test 09:30 HRS
8. Depth of hole 5,100'
9. Size of last casing string 11 3/4"
10. Depth to top of casing (Casing Lap) SURFACE
11. Depth to bottom of casing (Casing Shoe) 5,077'
12. (a) Pressure at which casing tested (to Master Valve) 2,500 psi
    (b) Drop in Pressure to (after 30 minutes) NONE
13. (a) Pressure at which Upper Blind Rams tested 2,500 psi
    (b) Drop in Pressure to (after 30 minutes) NONE
    (c) Pressure at which Lower Blind Rams tested 2,500 psi
    (d) Drop in Pressure to (after 30 minutes) NONE
14. (a) Pressure at which Upper Pipe Rams tested 2,500 psi
    (b) Drop in Pressure to (after 30 minutes) NONE

STATE OF HAWAII
Department of Land and Natural Resources
Land Division
Engineering Branch

FORMATION
~~CEMENT PLUG~~ **PRESSURE TEST**

Instructions: Please print or type and send completed form with any attachments to Land Division, P.O. Box 373, Honolulu, Hawaii 96809

Reference DLNR Regulations:
HRS 13-183-76 (b) All casing strings shall be pressure tested after cementing and before commencing any other operations on the well. Minimum casing test pressure shall be approximately one-third of the manufacturer's rated internal yield pressure; provided that the test pressure shall not be less than six hundred pounds per square inch and greater than 1500 pounds per square inch. In cases where combination strings are involved, the above test pressures shall apply to the lowest pressure-rated casing used. Test pressures shall be applied for a period of thirty minutes. If a drop of more than ten percent of the test pressure should occur, the casing or cement job shall be considered defective and corrective measures shall be taken before commencing any further operations on the well.

Cement Plug Pressure Test:

1. Project name PUNA RESOURCES RECOVERY PROJECT
2. Drilling company TRUC
3. Well name and number KS-5
4. Location PUNA SITE
5. Person(s) taking test CLIFFORD SHEEHAN
6. Date of test 11/19/02
7. Time of test 17:30 HRS
8. Size of casing string in which plug is set FORMATION @ 14 3/4"
9. Depth to top of plug 5,078'
10. Depth to bottom of plug 5,100'
11. Pressure at which casing tested (to Master Valve) 10.3 EQUIVALENT @ 300 PSI SURFACE
12. Drop in pressure to (after 30 minutes) NONE

Other Information: (use additional sheet, if necessary).

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

43615

PUNA GEOTHERMAL VENTURE
HAWAII

November 21, 2002

Mr. Wilfred Nagamine, Chief
Clean Air Branch
Environmental Management Division
Hawaii Department of Health
P.O. Box 3378
Honolulu, HI 96801

SUBJECT: 48-HOUR NOTIFICATION OF THE COMMENCEMENT OF FLOW TESTING KAPOHO STATE 5 (KS-5) PRODUCTION WELL

Dear Mr. Nagamine:

In accordance with the Noncovered Source Permit (NSP) No. 0008-02-N, Attachment IIB, Section D.2, Puna Geothermal Venture (PGV) hereby notifies the Hawaii State Department of Health that PGV will commence the Flow Testing of production well Kapoho State 5 (KS-5) on or around November 25, 2002, or shortly thereafter. This is an update to previous notifications.

If you need any additional information, please do not hesitate to contact me at (808) 965-6233.

Sincerely,

Mikael Kaleikini
for
Barry T. Mizuno
Owner's Representative

cc: Nolan Hirai, HDOH
Ed Yamamoto, HDOH
M. Kaleikini / B. Wiebe, PGV
Gilbert Coloma-Agaran, DLNR
Eric Tanaka, DLNR

T:\BTM\CORRES.OUT\DOH\KS-5\021122flo48hrnot.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4

Notification To Our Neighbors

November 20, 2002

PUNA
GEOTHERMAL VENTURE
HAWAII

PUBLIC NOTIFICATION OF CLEAN-OUT OPERATIONS OF KAPOHO STATE 5 (KS-5)

As required by permit and our commitment to keeping our immediate neighbors informed, Puna Geothermal Venture (PGV) hereby gives notice of plans to commence abated well clean-out operations for the new geothermal production well, Kapoho State 5 (KS-5) on or about November 25, 2002, or shortly thereafter.

Should you have any questions, please feel free to call the numbers listed below.

PGV Information Line – 934-9072	For information concerning the daily status and operation of the plant.
PGV's Response Line – 965-8843	A company representative will return your call.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT COLOMA-AGARAN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
ERIC T. HIRANO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:LD/WL-EK

OCT 25 2002

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778

Dear Mr. Mizuno:

Approval of Request to Perform Surveys of Production Well KS-11

Pursuant to Section 13-183-56, Hawaii Administrative Rules (HAR), approval for the surveys of production well KS-11, requested in your letter of October 16, 2002, is hereby granted.

All operations shall be in accordance with Chapter 13-183, HAR. Please contact the Department's representative, Eric Tanaka (Geothermal Compliance Specialist) in the Hilo office at 974-6210, for operations scheduling.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, in Honolulu at (808) 587-0230.

Sincerely,

GILBERT COLOMA-AGARAN

c: Mr. Darin Lum,
DOH Clean Air Branch

bc: Eric Tanaka

43277

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

October 16, 2002

Mr. Gilbert Coloma-Agaran, Chairman
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Subject: KS-11 Surveys

Dear Mr. Coloma-Agaran:

Puna Geothermal Venture ("PGV") hereby requests approval to perform surveys on production well KS-11. These surveys would include, but are not limited to, pressure, temperature, gauge ring and/or caliper. This data is required to further assess the situation. Contingent upon approval, the surveys would be conducted on October 30 and 31, 2002 or shortly thereafter.

The possibility of minor venting may occur from the lubricator that is used during the survey operations. The duration of venting will be approximately three minutes. During the logging operation the unabated H2S is calculated at <1 lb. after abatement through the portable abatement unit.

Should you have any questions, please call me at (808) 965-6233.

Sincerely,

Mikaell Kaleikini
for

Barry T. Mizuno
Owner's Representative

C: E. Tanaka (DLNR)
B. Wiebe (PGV)

T:\BTM\CORRES.OUT\DLNR\MIT\021016KS-11.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

Alyson K Yim
10/17/2002 08:16 AM

To: Nami J Wong/DLNR/StateHiUS@StateHiUS
cc:
Subject: Draft Approval for Survey of KS-11

Nami-
Please process after we receive the original from PGV.
Thanks,
Alyson

----- Forwarded by Alyson K Yim/DLNR/StateHiUS on 10/17/2002 08:18 AM -----

"Engineering Branch Hilo" <hdlog@interpac.net>
10/17/2002 08:13 AM

To: "Alyson Yim" <alyson_k_yim@exec.state.hi.us>
cc:
Subject: Draft Approval for Survey of KS-11

Hi Aly:

Attached is a draft for approval for a request from PGV to survey KS-11 during the annual shut down of the plant. The request was just mailed to Honolulu.

Eric ks-11survey101602.wp

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
Eric Hirano

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS
WATER RESOURCE MANAGEMENT

ENFORCEMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 621
HONOLULU, HAWAII 96809

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778

Dear Mr. Mizuno

Approval of Request to Perform Surveys on Production Well KS-11

Pursuant to Section 13-183-56, Hawaii Administrative Rules (HAR), approval for the survey work on Production Well KS-11, as requested in your letter of October 16, 2002, is hear-by granted.

All operations shall be in accordance with the Chapter 13-182, HAR. Please contact our Department representative, Eric Tanaka (Geothermal Compliance Specialist) in Hilo at 974-6210 for operations scheduling.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer in Honolulu, at (808) 587-0230.

Sincerely,

GILBERT COLOMA-AGARAN

c: Mr. Darin Lum,
DOH Clean Air Branch
bc: Eric Tanaka

Puna Geothermal Venture
Physical Address: (FedEx & UPS)
14-3860 Kapoho Pahoa Road
Pahoa, HI 96778

PUNA GEOTHERMAL VENTURE
HAWAII

Billing/Mailing Address:
P.O. Box 30, Pahoa, HI 96778
Telephone: (808) 965-6233
Facsimile: (808) 965-7254

FACSIMILE TRANSMISSION

To: NAMI
From: BILL WIEBE
Company: DLNR
Date: 10-23-02
Pages: 2 **(including cover page)**
CC:
FAX:

☐ *Yes* ☐ *No* **Original to be mailed**

Message:

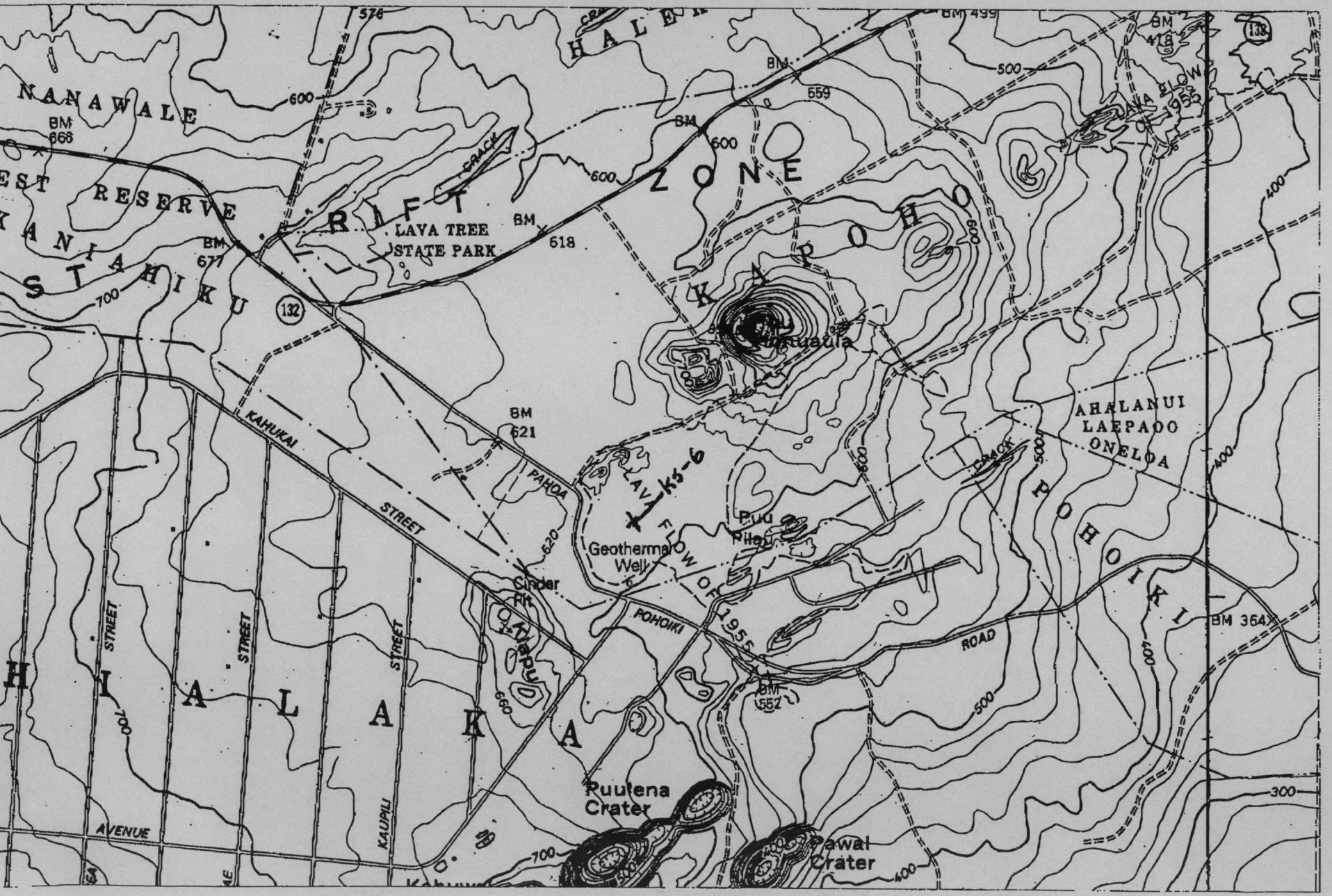
NAMI,

THIS ONE SHOWS KS-6

THANK

BILL

Figure 3


NANAWALE
BM 668
ESTATE RESERVE
KANIAHIKU
BM 677
700
132
RIFT ZONE
LAVA TREE STATE PARK
BM 618
CRACK
600
BM 559
BM 600
HALEMAUMAU
BM 499
500
LAVA FLOW OF 1955
BM 415
138
400
KAPOHO
Kapuaula
AHALANUI
LAEPAOO
ONELOA
CRACK
PAHOA
BM 621
KAHUKAI
STREET
LAVA FLOW OF 1955
K5-6
Puu Pilau
Geothermal Well
620
Cinder Pit
Puu
POHOIKI
ROAD
BM 364
BM 552
HILAKA
660
Puulena Crater
Kawai Crater
AVENUE
KAUPILI
300

Puna Geothermal Venture
Physical Address: (FedEx & UPS)
14-3860 Kapoho Pahoa Road
Pahoa, HI 96778

PUNA GEOTHERMAL VENTURE
HAWAII

Billing/Mailing Address:
P.O. Box 30, Pahoa, HI 96778
Telephone: (808) 965-6233
Facsimile: (808) 965-7254

FACSIMILE TRANSMISSION

To: NAMI
From: BILL WIEBE
Company: DLNR
Date: 10.23.02
Pages: 3 **(including cover page)**
CC:
FAX: 587-0283

☐ *Yes* ☐ *No* **Original to be mailed**

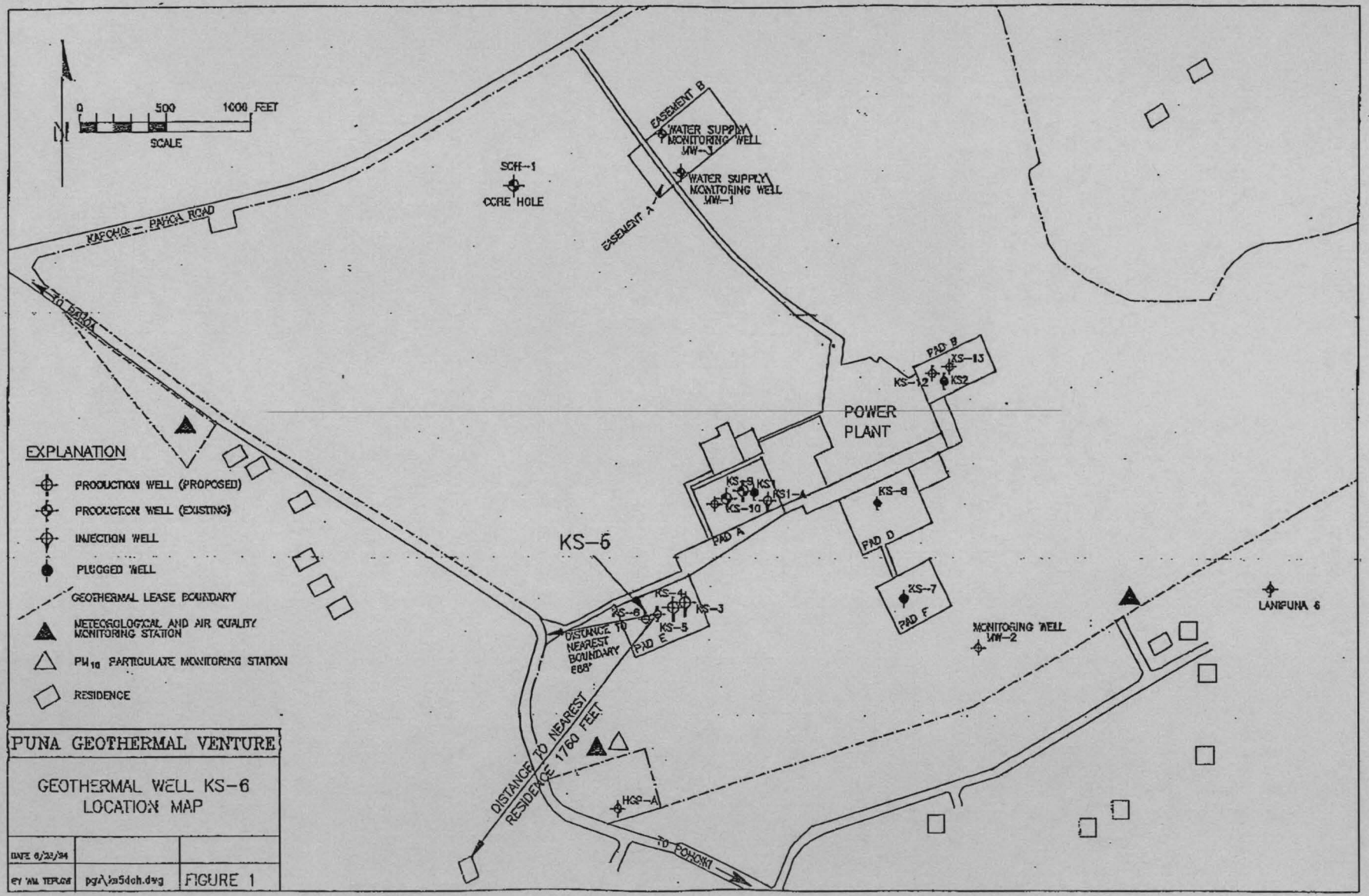
Message:

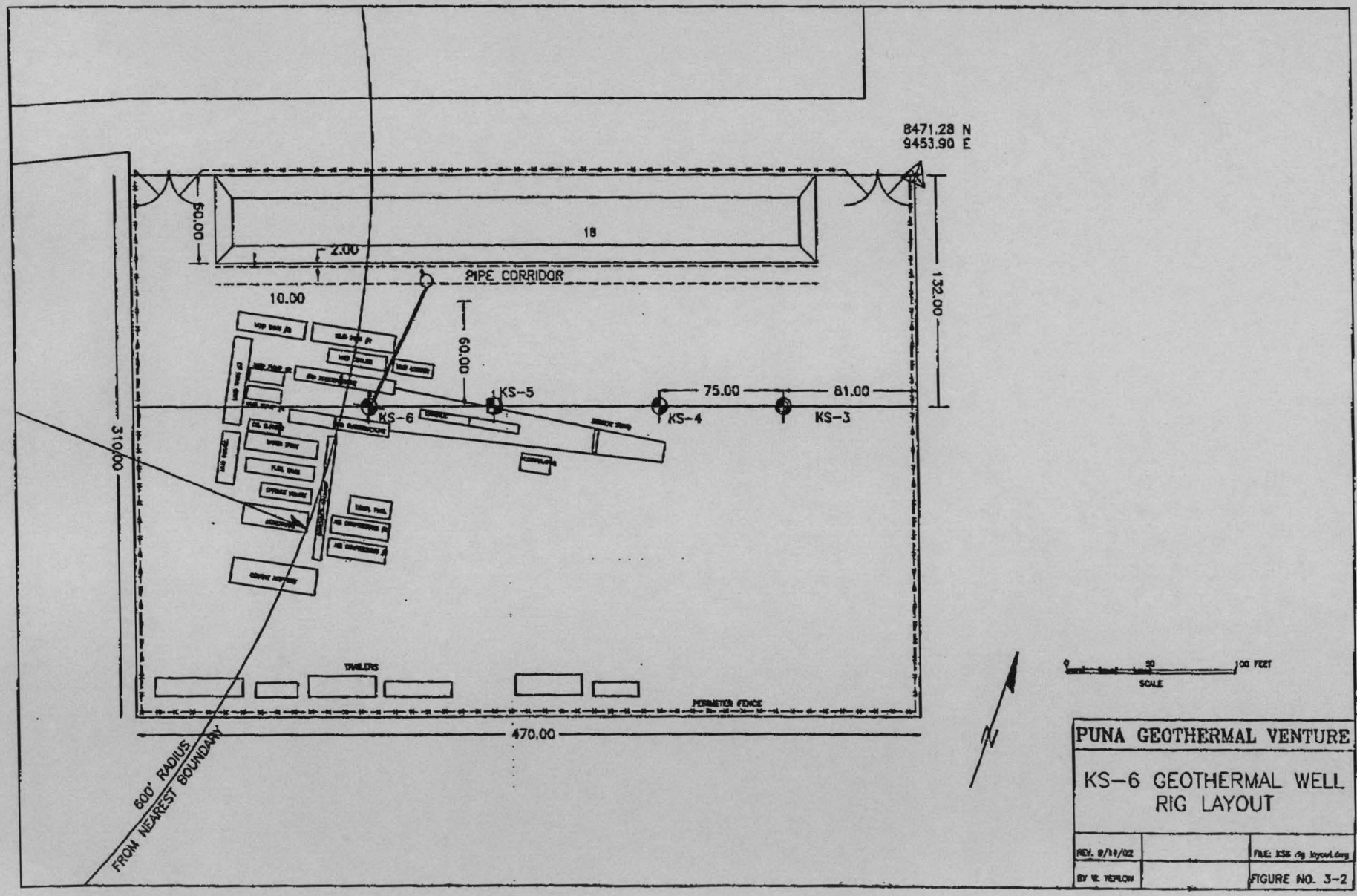
NAMI,

THE FIRST MAP (FIGURE 1) SHOWS THE ENTIRE SITE WITH ALL OF THE WELLPADS & WELL LOCATIONS. KS-6 IS POINTED OUT. THE SELOND (MAP FIGURE 3-2) SHOWS WELLPAD E. THIS IS HOW THE DRILLING RIG WILL BE SITUATED ON KS-6.

THANK
BILL

C:\WINDOWS\Desktop\OEN FAX.doc


0 500 1000 FEET
SCALE
N
SCH-1
CORE HOLE
EASEMENT B
WATER SUPPLY MONITORING WELL MW-1
WATER SUPPLY MONITORING WELL MW-1
EASEMENT A
KAPOHO - PAHOA ROAD
TO PAHOA
POWER PLANT
PAD B
KS-13
KS-12
KS2
KS-9
KS1
KS-10
KS1-A
KS-8
PAD A
PAD D
KS-7
PAD F
KS-6
KS-4
KS-3
KS-5
PAD E
DISTANCE TO NEAREST BOUNDARY 688'
DISTANCE TO NEAREST RESIDENCE 1760 FEET
HGP-A
TO KAPOHO
MONITORING WELL MW-2
LANIPUNA 6
EXPLANATION
PRODUCTION WELL (PROPOSED)
PRODUCTION WELL (EXISTING)
INJECTION WELL
PLUGGED WELL
GEOTHERMAL LEASE BOUNDARY
METEOROLOGICAL AND AIR QUALITY MONITORING STATION
PM10 PARTICULATE MONITORING STATION
RESIDENCE
PUNA GEOTHERMAL VENTURE
GEOTHERMAL WELL KS-6 LOCATION MAP
DATE 6/23/94
BY WM TEPLOW
pgv\ks5doh.dwg
FIGURE 1


8471.28 N
9453.90 E
50.00
18
2.00
PIPE CORRIDOR
10.00
60.00
132.00
KS-5
KS-6
KS-4
KS-3
75.00
81.00
310.00
TRAILERS
PERIMETER FENCE
470.00
600' RADIUS
FROM NEAREST BOUNDARY
50
100 FEET
SCALE
PUNA GEOTHERMAL VENTURE
KS-6 GEOTHERMAL WELL
RIG LAYOUT
REV. 9/19/02
FILE: KS6 rig layout.dwg
BY W. YERLOW
FIGURE NO. 3-2

Puna Geothermal Venture
Physical Address: (FedEx & UPS)
14-3860 Kapoho Pahoa Road
Pahoa, HI 96778

PUNA GEOTHERMAL VENTURE
HAWAII

Billing/Mailing Address:
P.O. Box 30, Pahoa, HI 96778
Telephone: (808) 965-6233
Facsimile: (808) 965-7254

FACSIMILE TRANSMISSION

To: NAMI
From: BILL WIEBE
Company: DLNR
Date: 10-23-02
Pages: 2 **(including cover page)**
CC:
FAX:

☐ *Yes* ☐ *No* **Original to be mailed**

Message:

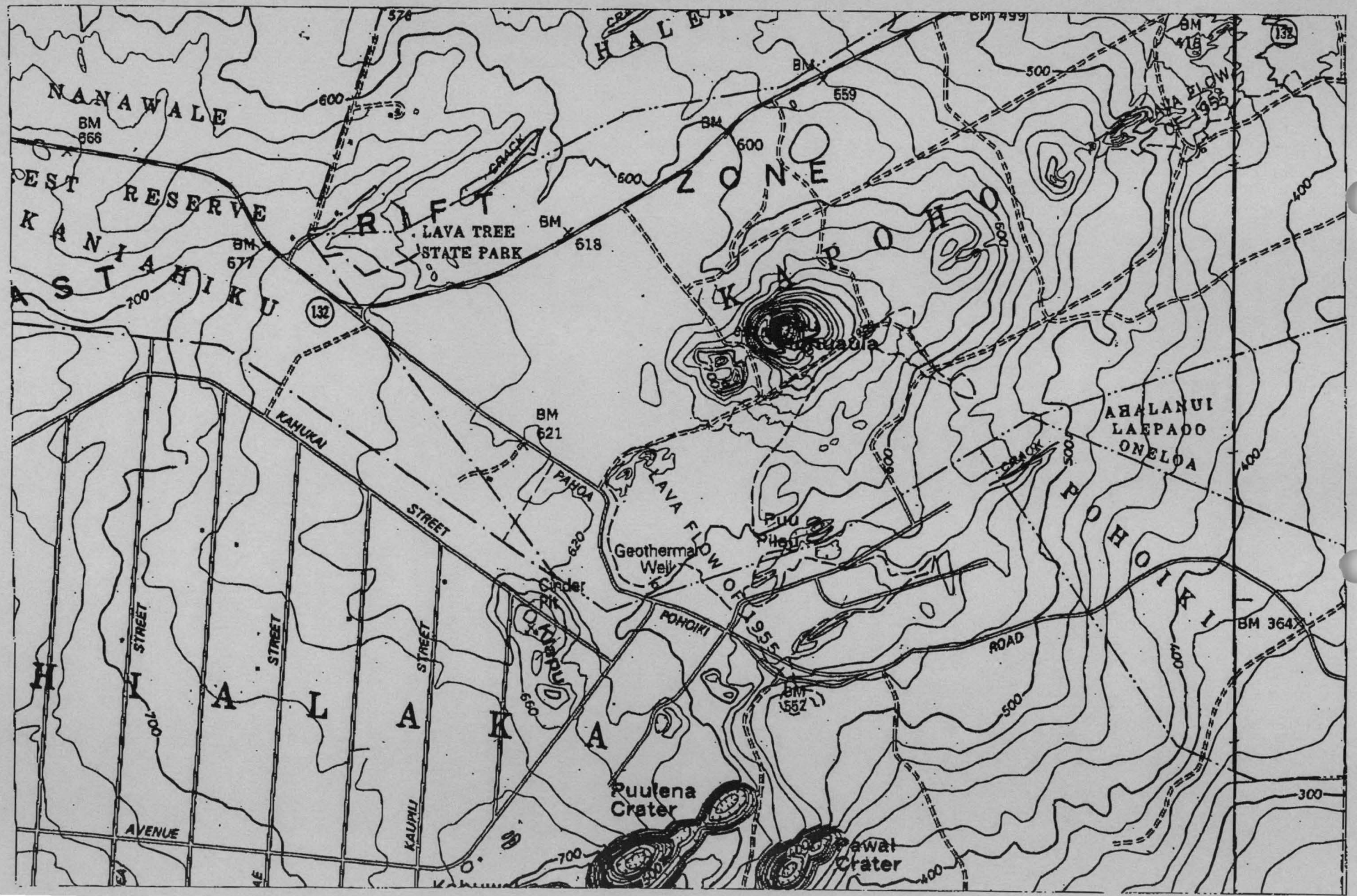
NAMI,

THIS MAP SHOULD REPLACE FIGURE THREE.
PLEASE CALL IF YOU HAVE ANY QUESTIONS
965-6233 EXT 248

THANK
BILL WIEBE

C:\WINDOWS\Desktop\GENFAX.doc

Figure 3


NANAWALE
BM 666
FOREST RESERVE
KAHIAHIKU
RIFT ZONE
LAVA TREE STATE PARK
CRACK
BM 618
BM 677
700
132
KAHUKU
BM 621
PAHOA
STREET
620
Cinder Pit
Kapuaiwa
660
HILAKAA
Puulena Crater
Kahuwai
AVENUE
KAUPILI
700
400
LAVA FLOW OF 1955
Puu Pilau
Geothermal Well
POHOIKI
ROAD
BM 552
AHALANUI
LAEPADO
ONEOA
POHOIKI
BM 364
300
BM 559
BM 600
500
600
BM 499
BM 416
LAVA FLOW 1955

4-2179

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

GHT

October 9, 2002

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

SUBJECT: KAPOHO STATE NO. 6 (KS-6) WELL DRILLING PERMIT REQUEST

Dear Mr. Coloma-Agaran:

Puna Geothermal Venture (PGV) hereby requests a geothermal drilling permit for Kapoho State No. 6 (KS-6) Well. This letter, application, and attachments will replace the letter, application, and attachments sent on September 27, 2002.

The September 27 letter contained a check for $100 for the filing fee and should apply to this replacement letter.

Should you have any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Michael Kaleikini
for

Barry T. Mizuno
Owner's Representative

Enclosures: Replacement Application for Permit to Drill KS-6

cc: M. Kaleikini/B. Wiebe, PGV
E. Tanaka, DLNR

T:\BTM\CORRES.OUT\DLNR\KS-6\021009 appl ltrKS6.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

PUNA GEOTHERMAL VENTURE
HAWAII

PUNA GEOTHERMAL VENTURE
PETTY CASH ACCOUNT
[redacted]

[redacted]

DATE 9/27/02

PAY One Hundred Dollars and 00/100 DOLLARS $ 100.00

TO THE ORDER OF
Department of Land and Natural Resources

[redacted]

PUNA GEOTHERMAL VENTURE
PETTY CASH ACCOUNT
PAHOA, HI 96778

DETACH AND RETAIN THIS STATEMENT
THE ATTACHED CHECK IS IN PAYMENT OF ITEMS DESCRIBED BELOW
IF NOT CORRECT, PLEASE NOTIFY US PROMPTLY. NO RECEIPT DESIRED

DATE	DESCRIPTION	AMOUNT
9/27/02	#9059 - KS6 Drilling Permit Filing Fee - 6150-8500	100.00

Puna Geothermal Venture
P.O. Box 30
Pahoa, HI 96778

Telephone: 808-965-6233
Facsimile: 808-965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

TO: Nami, 808-587-0283

FROM: Deborah Oliver, PGV, ext. 221

DATE: Monday, October 07, 2002

RE: Attachment – Correction for letter dated 9/27/02 – KS-6 Well Drilling Permit Request

---

Aloha,
Per our telephone conversation, I've enclosed Attachment 1. In reviewing the attachments, I noticed Attachment II had KS-5 in the heading, the corrected version if attached.

[redacted]

Superceded

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

43097

PUNA GEOTHERMAL VENTURE
HAWAII

GA

September 27, 2002

Pls route directly to WL.

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

SUBJECT: KAPOHO STATE NO. 6 (KS-6) WELL DRILLING PERMIT REQUEST

Dear Mr. Coloma-Agaran:

Puna Geothermal Venture (PGV) hereby requests a geothermal drilling permit for Kapoho State No. 6 (KS-6) Well.

A check in the amount of $100.00 for the filing fee is enclosed.

Should you have any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

Enclosures: Application for Permit to Drill KS-6
Filing Fee Check

cc: M. Kaleikini/B. Wiebe
E. Tanaka

T:\BTM\CORRES.OUT\DLNR\KS-6\020912 appl ltrKS6.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

42828

PUNA
GEOTHERMAL VENTURE
HAWAII

RECEIVED
02 SEP 9 A8:16
DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

September 4, 2002

Mr. Darin Lum
State Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Lum:

Pursuant to our telephone conversation on September 4, 2002, and Condition IIB.B.5 of Puna Geothermal Venture's (PGV) Noncovered Source Permit (NSP) No. 0008-02-N, PGV respectfully requests approval for an exemption in modifying the existing NSP to operate the following piece of equipment. The equipment used is an air compressor with a Cummins Diesel Engine that pumps large volumes of air down the drill pipe. PGV anticipates a nominal total use of twenty-hours run time from this compressor.

During the process of drilling the 26" section of hole, the drilling assembly (drill bit & other components) became stuck at ~600 feet. Our task-at-hand is to get the drilling assembly unstuck. PGV is planning to use airflow from the compressor to enhance the capability of moving the solids (primarily rock cuttings) trapped around the drilling assembly area. PGV has been in frequent contact with the DLNR Geothermal Compliance Specialist, Eric Tanaka, and has received Mr. Tanaka's verbal consensus for using this procedure.

The following equipment will be used:

One (1) Cummins Diesel Engine, Model KTA 1150C, 525 HP
Serial Number 1162, Built 1981
Maximum Fuel Consumption, 27.4 gal/hr.
Exhaust Diameter: 8", Direction UP, Exhaust Height 9'

Should there be any questions, please do not hesitate to contact me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

cc: Nolan Hirai/ Ed Yamamoto - HDOH
Gilbert Coloma-Agaran/ Eric Tanaka - DLNR
Mike Kaleikini/ Bill Wiebe- PGV

T:\BTM\CORRES.OUT\DOH\KS-5\020904.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

42970

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

GK

September 19, 2002

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

SUBJECT: **KAPOHO STATE 5 (KS-5) PRODUCTION WELL**

Dear Mr. Coloma-Agaran:

Pursuant to Puna Geothermal Venture (PGV) Well Drilling Permit dated April 10, 2002, PGV hereby gives notification to the Department of Land and Natural Resources (DLNR) of the possibility to skid the drilling rig over ~ 20' to the East and re-drill production well KS-5. PGV has been unsuccessful thus far in retrieving pipe that became stuck in the hole on August 27, 2002. The work is tentatively scheduled to commence on September 20, 2002, or shortly thereafter.

The intended target of KS-5 will remain the same and is located 278.54' East, 25.93' South, and at a depth of 6330.72' True Vertical Depth (TVD). The direction of the proposed deviation is approximately 300' East of the wellhead location.

Should there be any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

cc: Eric Tanaka, DLNR
Mike Kaleikini, PGV
Bill Wiebe, PGV

T:\BTM\CORRES.OUT\DLNR\KS-5\020919KS-5sidetrack.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

42969

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

September 18, 2002

GB

Mr. Gilbert Coloma-Agaran
Department of Land and Natural Resources
P.O.Box 621
Honolulu, Hawaii 96809

SUBJECT: **NOTIFICATION OF COMMENCEMENT TO RE-DRILL KAPOHO STATE 11 (KS-11) WELL**

Dear Mr. Coloma-Agaran:

Pursuant to Puna Geothermal Venture (PGV) Well Drilling Permit dated May 10, 2002, PGV hereby gives notification in writing to the Department of Land and Natural Resources (DLNR) of the intent to re-drill Kapoho State 11 (KS-11) well. The work is tentatively scheduled to commence on or around November 27, 2002 or shortly thereafter.

The intent is to drill KS-11 into the same general location where the injection wells KS-3 and KS-4 bottom hole targets are presently located. The intended target of KS-11 is located 468' West, 168' North, and at a depth of 8000' True Vertical Depth (TVD). The direction of the proposed deviation is approximately 800 feet north of the well head location.

Should there be any questions, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

cc: Eric Tanaka, DLNR
Mike Kaleikini, PGV
Bill Wiebe, PGV

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We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

42828

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

September 4, 2002

Mr. Darin Lum
State Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Lum:

Pursuant to our telephone conversation on September 4, 2002, and Condition IIB.B.5 of Puna Geothermal Venture's (PGV) Noncovered Source Permit (NSP) No. 0008-02-N, PGV respectfully requests approval for an exemption in modifying the existing NSP to operate the following piece of equipment. The equipment used is an air compressor with a Cummins Diesel Engine that pumps large volumes of air down the drill pipe. PGV anticipates a nominal total use of twenty-hours run time from this compressor.

During the process of drilling the 26" section of hole, the drilling assembly (drill bit & other components) became stuck at ~600 feet. Our task-at-hand is to get the drilling assembly unstuck. PGV is planning to use airflow from the compressor to enhance the capability of moving the solids (primarily rock cuttings) trapped around the drilling assembly area. PGV has been in frequent contact with the DLNR Geothermal Compliance Specialist, Eric Tanaka, and has received Mr. Tanaka's verbal consensus for using this procedure.

The following equipment will be used:

One (1) Cummins Diesel Engine, Model KTA 1150C, 525 HP
Serial Number 1162, Built 1981
Maximum Fuel Consumption, 27.4 gal/hr.
Exhaust Diameter: 8", Direction UP, Exhaust Height 9'

Should there be any questions, please do not hesitate to contact me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

cc: Nolan Hirai/ Ed Yamamoto - HDOH
Gilbert Coloma-Agaran/ Eric Tanaka - DLNR
Mike Kaleikini/ Bill Wiebe- PGV

T:\BTM\CORRES.OUT\DOH\KS-5\020904.doc
We certify that this document and all attachments are true, accurate, and complete, pursuant to HAR 11-60.1-4.

Geothermal drilling starts again in Puna

By Hugh Clark
ADVERTISER BIG ISLAND BUREAU

POHOIKI, Hawai'i — Puna Geothermal Venture began the first of three new drilling operations over the weekend at its plant east of Pāhoa.

The initial phase, according to spokesman Barry Mizuno, is to establish Kapoho State 5 well (KS-5), due to begin producing power in December, when consumer demand in Hawai'i County reaches its peak.

Later, drillers are to convert the KS-11 well into a re-injection well to accept the highly corrosive and smelly hydrogen-sulfide fluid that is a byproduct of geothermal power production. Then, a second new well will be drilled.

The $16 million job was contracted to True Geothermal of Wyoming.

Puna Geothermal has a contract with Hawai'i Electric Light Co. to produce up to 30 megawatts of electricity using underground heat sources.

Since KS-11 went out of service, the company has been able to provide only 5 megawatts.

Residents near the well sites, about 23 southeast of Hilo, are not happy that drilling is under way.

Al Dettweiler of the community group Puna Mālama Pono said he is concerned about the noise, even though it does not violate state standards for an agricultural district. Sound from drilling operations has been measured at 42 to 45 decibels, well below the 70-decibel limit.

"It's noisy to us," he said. "Human beings do not live by the numbers."

Longtime geothermal critic Jon Olsen of nearby Leilani Estates said county and state officials continue to have too little control over the developer.

Mizuno said his firm is meeting commitments made to state and county regulators, and attempting to be a good neighbor to the Lanipuna Gardens and Leilani Estates residential areas, both within a quarter-mile of the project.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105
Mail Code: WTR-9

July 10, 2002

Barry Mizuno, Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, HI 96778

Re: Mechanical Integrity Testing

Dear Mr. Mizuno:

Thank you for the 45-day notice preceding the mechanical integrity testing (MITs) of your injection wells. This is to notify you that EPA personnel, and possibly BLM personnel who are under contract to EPA, will witness the temperature, pressure, and annulur nitrogen pressure tests for KS-4. Witnessing a round of MITs is a normal part of our permitting process when we issue a permit.

I understand from Mike Kaleikini's June 29, 2002 telephone call with Shannon FitzGerald that MITs will be performed on KS-4 in the latter part of October 2002. Please notify us when you have an exact date for the tests so we can make travel arrangements. I also appreciate and accept the offer of either hydrogen sulfide training or air escape pack for those who witness the MITs.

If you have any questions regarding any of these matters, please call Shannon FitzGerald at (415) 972-3531.

Sincerely,

Laura Tom Bose

Laura Tom Bose
Manager
Ground Water Office

cc: Kenny Stein, Constellation Energy
George Robin, EPA
Sean Hagarty, BLM
Joe Hughes, BLM
William Wong, DOH
Chauncey Hew, DOH
√ Andrew Mondon, DLNR
Eric Tanaka, DLNR

received 7/15/02
from E. Tanaka

P.O. Box 30
Pahoa, HI 96778
Telephone: 965-6233 – Fax: 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

FAX

To:	Kenny Stein	**Fax:**	(410) 230-4849
	Jim Willey		(760) 242-4290
	Rob Eckert		(949) 852-1720

From: Jan Kama for Barry T. Mizuno

Date: January 3, 2001

Re: Mediation of Proposed Amendments to GRP – Final Report

Pages: 22

We are transmitting the attached for your information/files.

Copies to: Mike Kaleikini
Darren Hunt

Tsukazaki Yeh & Moore
ATTORNEYS AT LAW
A Limited Liability Law Company

100 Pauahi Street, Suite 204 Hilo, Hawaii 96720
Telephone: (808) 961-0055 Fax: (808) 969-1531

R. BEN TSUKAZAKI
THOMAS L.H. YEH
MICHAEL W. MOORE

January 2, 2001

FACSIMILE TRANSMISSION COVER SHEET

To:	BARRY MIZUNO Puna Geothermal Venture
Fax No.:	965-7254
From:	Suzanne Redmill, ALS Assistant to R. Ben Tsukazaki TSUKAZAKI YEH & MOORE
Re:	Mediation of ProposedAmendments to Geothermal Resource Permit 87-1
Description of Document:	*FINAL REPORT* [By Colin L. Love, Mediator, Dated December 30, 2000]
Message:	We are transmitting the attached for your information/files.

Number of pages to follow this cover sheet: 20

IF ANY PART OF THIS TRANSMISSION IS MISSING OR POORLY RECEIVED, PLEASE CALL SUZANNE REDMILL OF TSUKAZAKI YEH & MOORE AT THE ABOVE NUMBER. IF YOU DO NOT CALL, WE WILL ASSUME THAT YOU HAVE RECEIVED THE DESIGNATED NUMBER OF PAGES SATISFACTORILY.

COLIN L. LOVE
Post Office Box 2072
Kailua-Kona, HI 96745
Telephone and Fax (808) 329-2460

IN THE MATTER OF THE MEDIATION OF
PROPOSED AMENDMENTS TO GEOTHERMAL RESOURCE PERMIT (GRP2)

FINAL REPORT

Section 1 -- Introduction

The undersigned was appointed by the Planning Commission for the County of Hawaii to act as mediator of disputes arising out of the Puna Geothermal Venture "Application For Amendment to Geothermal Resource Permit (87-1)"[1] . The appointment was made on November 20, 2000, in accordance with Rule 12 Geothermal Resource Permits.

The Puna Geothermal Venture Application for Amendment to Geothermal Resource Permit No. 2 ("GRP2") came on for hearing at before the Planning Commission of the County of Hawaii at its regularly advertised hearing on October 20, 2000. Testimony from the Applicant and recommendations from the Planning Director of the County of Hawaii were received by the Planning Commission. The procedure for requesting mediation in accordance with Rule 12 was explained to the Planning Commission and the attending public by Phyllis Fujimoto, Staff Planner.

Rule 12-5-1 Mediation provides in pertinent part as follows:

(a) Persons Entitled to Request Mediation. Any person, including interested government agencies, who submitted comment at the public hearing may, upon appropriate request, seek mediation of issues raised by that person at the initial public hearing...

(b) Requests for Mediation. A request for mediation shall be made in writing to the Planning Commission, shall contain a brief statement of the issue or issues raised by that person at the public hearing...

(c) Time for Submission of Requests. The original and ten (10) copies of the request for mediation shall be filed with the Planning Commission within five (5) days after the close of the initial public hearing...

The subject amendment to GRP2 sought to amend 21 of the 50 Conditions to GRP2. The members of the public wishing to comment at the hearing were each given five-minutes to do so. Those submitting verbal comments at the hearing were Penelope Shaver, Aurora Martinovich, Steve Philips, Steve Philips read a statement by Andy Levin, Jennifer Perry, Jennifer Perry speaking for Jane Hedtke, Donald Medeiros, Rene Siracusa for herself and Malama O Puna, Gene Thomas, Jan Malasek, Robert Meierdiercks, Henry Horton, David Zeissler, Robert Petricci, Patti Cook, Diane Thomas, Jack Dean, Athena Peanut, Luana Jones, Jon Olson, and Steven Hirakami

[1] The Application for Geothermal Resource Permit was number 87-1, and the permit that was issued was Geothermal Resource Permit 2 (GRP2 herein).

Written submittals were receive at the October 20, 2000, hearing of the County of Hawaii Planning Commission from Aurora Martinovich, Gene Thomas, Kate Harrison, Donna and Steve Moynihan, Jane Hedtke, Robert A Kochy, Luana Jones, Diane Thomas, Al Dettweiler, James V. Albertini, Bonnie Bator, Andrew Levin, Donald Thomas, Paula Z Helfrich, Patti Cook, Charlotte Jackson, Leslie Isemoto, Glen Santos (Hawaii Island Geothermal Alliance), Randi Schneider, Donald Medeiros and Robert Cooper (Hawaii Island Chamber of Commerce).

Written requests for mediation were submitted by Steve Philips, Planning Department, William L. Bethea, Jennifer and Delan Perry, Paula Z. Helfrich (Hawaii Island Economic Development Board), Rene Siracusa (Malama O Puna), Marlene Dykema, Rev. William Applelton (Kahumana Sanctuary), Jack Dean, Donald Thomas, Forest Manderville, Meera Grove, Athena Peanut, Al Dettweiler.

The Planning Commission for the County of Hawaii determined that those qualifying under Rule 12 to participate in the mediation were Jack Dean, Marlene Dykeman, Jim Rice, Kate T. Harrison, Paula Z. Helfrich, Luana Jones, Steve Moynihan, Dianna Moynihan Delan Perry, Jennifer Perry, Steve Philips, Rene Siracusa, Al Dettweiler, Annie Szvetecz, Robert A. Kochy, Aurora Martinovich, Athena Peanut, Donald Thomas, Gene Thomas, the Planning Department for the County of Hawaii and Puna Geothermal Venture (PGV).

The assignment given to the mediator in this case was to "submit a written report containing recommendations to the Planning Commission, based upon an mediation agreement reached between the parties or stating that no agreement was reached, for consideration by the Planning Commission in it final decision." In the event that all of the issues submitted for mediation were not resolved the referenced requirement is read to instruct the mediator to submit a report describing those agreements that were reached.

Section 2 -- Positions of the Parties

The goal of PGV is to increase the power production under their resource permit from 30 MW to 60 MW sometime in the future. The stated purpose of the amendments to the conditions to GRP2 was to "...allow PGV generate up to 60MW of electricity on site consistent with applicable regulatory standards and permits utilizing new technology and equipment upgrades. PGV is also requesting the amendments of the conditions of the GRP to incorporate regulatory standards and permit requirements that have been promulgated and issued since the GRP was originally approved in 1989."[2] PGV contends that the increase in power production will be in phases, as Hawaii Electric Light Company (HELCO) requires the additional power. The initial phases will not necessarily require the drilling of additional wells. They will involve upgrading existing equipment and technology.

PGV and the five other parties to the mediation who generally supported the application took positions including but not limited to the following:[3]

- PGV wants to increase the amount of electricity produced by their facility and the proposed amendments to the conditions are required to allow them to do that, and

[2] Cover letter to Application for Amendment top Geothermal Resource Permit (GRP87-1) dated July 5, 2000.
[3] The positions stated for the respective parties are not intended to be exhaustive. They are provided only to give the Planning Commission a feel for the issues involved in the mediation process.

- At the time the original GRP was granted there were few if any State of Hawaii or Federal regulations applying to the industry, and
- There are now State and Federal regulations that apply to most of the activities that were previously unregulated, and
- The State and Federal regulations and standards are uniform and they should apply in the same manner to all industries,
- PGV should be allowed to increase the production of electricity from its project if it stays within the limits for noise, light and sulfide set by State and Federal limits, permits and regulations, and
- Other amendments are intended to merely update the permit to the status of the project as it is now, and
- PGV has been paying $50,000 per year into the Asset Fund but money from the Asset Fund is not being used as intended.

The eleven parties who submitted written statements to the mediator and/or participated in at least some of the mediation sessions and opposed some or all of the amendments generally took including but not limited to:

- PGV has not complied with the terms and condition of its original permit, and
- The noise, hydrogen sulfide monitoring is in adequate now and should be increased if the electrical output from the project is increased, and
- At times the noise and light emanating from the project are excessive now, and
- The measures taken to control noise and light emanating from the project are inadequate now, and
- The Planning Director should be kept in the information loop because it is difficult to get information from State agencies, and
- The procedures for notifying the public in the event of an upset condition are inadequate, and
- Many of the Conditions sought to be amended were the result of prior mediation and PGV should not be allowed to avoid the results of that mediation and take advantage of lower State and Federal standards, and
- PGV should continue to pay into the Asset Fund as it is there to protect the communities.

Section 3 -- Mediation Process and Collateral Agreements

During the first mediation session, and by letter following that session, each of the participants was asked to submit a confidential mediation memorandum to the mediator. As to each of the proposed amendments the confidential memorandum was to state (1) whether the participant agreed or disagreed, (2) if they disagreed, the reason for their objection, and (3) any compromise position with respect to an objected to amended condition. Confidential mediation statements were received from Aurora Martinovich, the Planning Department, Jennifer and Delan Perry, Luana Jones, Athena Peanut, Annie Szvetecz, Gene and Diane Thomas, Al Dettweiler, Robert Kochy, Mr. and Mrs. Dru Harrison, Rene Siracusa, Paula Z. Helfrich, Jack Dean, Jim Rice and Marlene Dykema, and Donald Thomas.

The mediation process in this case was made more difficult because of timing. The hearings started under one County Government Administration and ended under another. The change in

administration created uncertainties in the minds of the participants as to the position that would be take by an important party to the mediation, the Planning Department and its Director. In particular, the prior Planning Director supported the Amendments to Conditions 21, 22, and 24. Those Conditions all deal with noise. Condition 24 provides, in essence, until the State establishes other standards the noise level at the residence nearest to the project shall be limited to 45 dBA during the night and 55 dBA during the day time. The new standard established by the Department of Health is 70 dBA. While PGV generally appears to be complying with the original noise level requirements, noise-monitoring data does indicate that there are times when 55 dBA is exceeded. PGV is not in violation because they comply with the current State standard. The current Planning Director indicated that he wanted to study the issue and that he may provide the Planning Commission with a different recommendation. The uncertainty created thereby made mediation of the issue impossible.

Although agreement was not reached on some of the core issues such as noise and H_2S emissions, agreement was reached on several issues. Also, a number of collateral agreements were entered into. PGV, the Planning Director and members of the community are continuing to try to work out some of the remaining problems. It is hoped that by the time of the Planning Commission meeting a joint recommendation will be made by the parties regarding some or all of the issues that could not be resolved in mediation.

It is the mediator's understanding that PGV agreed to the modification of several of its proposed amendments to Conditions and entered into collateral agreements in the anticipation that its request to increase power production to 60 MW would be granted. If that increase is not granted then it is the mediator's understanding that PGV's position is that none of the parties to this mediation should be held to anything that they agreed to.

The dates and times and parties attending mediation sessions are listed in Exhibit "A" attached hereto. Approximately 43-hours were spent in mediation sessions. Some of the sessions were held jointly with all of the parties and others were held with one faction or the other. The parties to the mediation all made a good faith effort to resolve their differences.

Of the 21 Amended Conditions submitted to mediation agreement was reached on 12 of them and two Collateral Agreement were entered into. It was not possible to reach an agreement on all of the matters submitted for mediation, and therefore there is no mediation agreement. Pursuant to Rule 12 (12-5-1(N)) the Planning Commission may hold a second public hearing to receive additional comments on unresolved issues.9

Section 4 – Proposed Amendments to Conditions

The proposed amendments to Condition 1 are as follows:

1. The Geothermal Resource Permit grants approval for those uses and improvements described in the "Geothermal Resource Permit Application Amendment for the Puna Geothermal Venture Project," dated March 1989, except as amended, modified, or conditioned by this Geothermal Resource Permit. Except as otherwise described in this permit, no other uses are authorized by this permit[,]. **The following uses are allowed under this Geothermal Resource Permit: turbines, generators, air coolers fans, air**

compressors, diesel driven pumps and motors, production wells, injection wells, steam separators and accumulators, electrical transformers, control valves, rock mufflers; H_2S abatement equipment, welding machines, drilling rigs and auxiliary equipment, etc designed and operated for the generation of up to 60 MW of geothermal power and any proposed other uses of the geothermal resource or improvements to the land, whether to be conducted by the permittee or a third-party under contract to, or other agreement with, the permittee, shall be subject to prior review and approval, consistent with the applicable Rules of Practice and Procedure of the Hawaii County Planning Commission. The Planning Director may, upon written request of the permittee, approve deviations from the project layout and uses permitted under this Geothermal Resource Permit if such amendments are consistent with the uses permitted and conditions of this Geothermal Resource permit. No action pursuant to any such request for deviation by the permittee shall be taken without the written approval of the Planning Director. Amendments to the Geothermal Resource Permit and its conditions may be granted pursuant to Article 12-9 of the Rules of Practice and Procedure of the County of Hawaii Planning Commission.

At the beginning of the mediation [4]there were 6 parties in favor of the amendment, 9 opposed and 2 took no position.[5] No significant change in the respective positions of the parties occurred. This proposed amendment was not agreed to.

The proposed amendments to Condition 4 are as follows:

4. During the [period] **periods** of construction [of the project,] or during the drilling or testing of any well, the permittee shall submit a weekly written status report to the Planning Department which shall include:

   a. A brief description of the work undertaken during the previous week under the Geothermal Resource Permit;

   b. A description of the work being proposed during the next week under the Geothermal Resource Permit; and

   c. Any other information that the Planning Department may reasonably require which addresses the immediate environmental and regulatory concerns of the

[4] Seventeen parties actively participated in the mediation. The were Aurora Martinovich, the Planning Department, Jennifer and Delan Perry, Athena Peanut, Annie Szvetecz, Gene and Diane Thomas, Al Dettweiler, Robert Kochy, Mr. and Mrs. Dru Harrison, Rene Siracusa, Paula Z. Helfrich, Jack Dean, Jim Rice and Marlene Dykema, Donald Thomas, Luana Jones and Puna Geothermal Venture. Steve Philips signed requested mediation but did not submit a confidential memorandum to the mediator and only attended 3 hours of the mediation sessions. Mr. And Mrs Moynihan requested mediation but did not participate in any way.

[5] Any reference in this Final Report to the positions taken by parties at the beginning of the mediation relative to any proposed amended Condition is a reflection of the mediator's understanding of whether a party was for or against a proposed amendment. Where this report states that some number of parties *took no position* it is because the mediator was not able to ascertain the parties position or because they did not participate in enough of the mediation sessions so that the mediator could become familiar with their position on the particular subject being addressed. The positions of those parties who demanded mediation but did not participate in the mediation hearings are not reflected in this report.

County of Hawaii or the requirements of the Geothermal Resource Permit.

At the beginning of the mediation there were 7 parties in favor of the amendment, 6 opposed and 4 who took no position. As the result of the mediation the parties agreed to the amendment to Condition 4 as proposed.

The proposed amendments to Condition 6 are as follows:

6. If any environmental monitoring data collected as required under this Geothermal Resource Permit indicates [that] **the** project operations are creating, or have the immediate potential of creating, excessive health or environmental effects not otherwise permitted by this Geothermal Resource Permit, the permittee shall [submit such data to the Planning Department within 48 hours of its identification.] **comply with the State of Hawaii Clean Air Branch Noncovered Source Permit (NSP) reporting requirements, and simultaneously provide a copy of such report(s) to the Planning Department.**

At the beginning of the mediation there were 4 parties in favor of the amendment, 11 opposed and 2 took no position. As the result of the mediation the parties agreed to amend Condition 6 as follows:

6. If any environmental monitoring data collected as required under this Geothermal Resource Permit indicates [that] **the** project operations are creating, or have the immediate potential of creating, excessive health or environmental effects not otherwise permitted by this Geothermal Resource Permit, the permittee shall [submit such data to the Planning Department within 48 hours of its identification.] **comply with the State of Hawaii Clean Air Branch Noncovered Source Permit (NSP) reporting requirements and provide immediate notice to the Department of Health, provide immediate notice to the Planning Director and provide a copy of any report(s) to the Planning Department simultaneously with the Department of Health.**

The proposed amendments to Condition 7 are as follows:

7. **The permittee shall comply with the Clean Air Branch, Safe Drinking Water Branch, and Department of Noise and Radiation Branch of the Department of Health's recordkeeping requirements.** The permittee shall maintain [a record] **records** in a permanent form suitable for inspection**, regarding noise, hydrogen sulfide emissions, equipment upsets, and any other sampling or analytical results,** and shall make such record available on request to the Planning Director or his designee. [The record shall include:

   a. Occurrence and duration of any start-up, shut-down, and operation mode of each geothermal well and/or facility;

   b. Performance testing, evaluation, calibration checks, and adjustment and maintenance of the continuous monitor(s) that have been installed; and

c. All measurements reported in units compatible with applicable standards/guidelines.]

At the beginning of the mediation there were 6 parties in favor of the amendment, 9 opposed and 2 who took no position. As the result of the mediation the parties agreed to the amendment to Condition 7 as proposed by PGV.

The proposed amendments to Condition 10 are as follows:

10. Prior to commencing any geothermal well drilling, testing, production, or injection activity approved under this Geothermal Resource Permit, the permittee shall submit [to, and secure the approval of, the Planning Director of] a hydrologic monitoring program **to the State Safe Drinking Water Branch. Semi-annual testing shall be performed in accordance with the Hydrological Monitoring Program (HMP) which is described in the Hawaii State Underground Injection Control (UIC) permit. All data and reports submitted to the Safe Drinking Water Branch shall be available for inspection by the Planning Director upon request**. [The program shall, at a minimum, provide for the quarterly monitoring of water levels and appropriate chemical species from existing wells completed within the shallow aquifer in those areas downgradient of the project area, including the Green Lake water supply, as well as from a well located within the project boundary and completed within the shallow aquifer. The monitoring, sampling, and analysis protocols shall be clearly defined in the program submitted to and approved by the Planning Director. The monitoring and sampling shall be conducted by a qualified contractor, and the samples analyzed by a qualified laboratory, selected by the permittee but subject to the approval of the Planning Director. The selected contractor and laboratory shall operate under contract to, and shall be funded by the permittee. The program shall monitor the shallow groundwater immediately prior to, and during, all periods of well drilling, testing, production, and injection activity approved under this Geothermal Resource Permit. The data obtained shall be submitted to the Planning Director in accordance with the requirements contained in this Geothermal Resource Permit for submittal of all collected environmental monitoring data. The County shall make random checks of the ground water supply no less than every two months.]

At the beginning of the mediation there were 5 parties in favor of the amendment, 10 opposed and 2 who took no position. As the result of the mediation the parties agreed to amend Condition 10 as follows:

10. Prior to commencing any geothermal well drilling, testing, production, or injection activity approved under this Geothermal Resource Permit, the permittee shall submit [to, and secure the approval of, the Planning Director of] a hydrologic monitoring program **to the State Safe Drinking Water Branch. Semi-annual testing shall be performed in accordance with the Hydrological Monitoring Program (HMP) which is described in the Hawaii State Underground Injection Control (UIC) permit. In addition thereto testing of the same wells shall be done within three (3) months after the Permittee submits its Well Completion Report to the Department Of Land and Natural Resources and after any event that may cause Permittee's activities to**

contaminate the ground water. All data and reports submitted to the Safe Drinking Water Branch shall be submitted to the Planning Director. [The program shall, at a minimum, provide for the quarterly monitoring of water levels and appropriate chemical species from existing wells completed within the shallow aquifer in those areas down gradient of the project area, including the Green Lake water supply, as well as from a well located within the project boundary and completed within the shallow aquifer. The monitoring, sampling, and analysis protocols shall be clearly defined in the program submitted to and approved by the Planning Director. The monitoring and sampling shall be conducted by a qualified contractor, and the samples analyzed by a qualified laboratory, selected by the permittee but subject to the approval of the Planning Director. The selected contractor and laboratory shall operate under contract to, and shall be funded by the permittee. The program shall monitor the shallow groundwater immediately prior to, and during, all periods of well drilling, testing, production, and injection activity approved under this Geothermal Resource Permit. The data obtained shall be submitted to the Planning Director in accordance with the requirements contained in this Geothermal Resource Permit for submittal of all collected environmental monitoring data. The County shall make random checks of the ground water supply no less than every two months.]

The proposed amendments to Condition 13 are as follows:

13. [In the event the Department of Water Supply determines that the existing Green Lake county water source becomes contaminated by the permittee's geothermal wellfield system, the permittee shall immediately provide alternative(s) to the water supply, including the hauling of water if necessary as a temporary alternative, which meet the approval of the County's Department of Water Supply and the State Department of Health.]

At the beginning of the mediation there were 6 parties in favor of the amendment, 7 opposed and 4 took no position. As the result of the mediation the parties agreed to the amendment to Condition 13 as proposed (the entire condition is to be deleted).

The proposed amendments to Condition 15 are as follows:

15. All drilling mud solids and drill cuttings shall be discharged to and contained within [the well pad sump] **a containment area**. A disposal site or sites approved by the State Department of Health, prior to any disposal activity covered by this permit, shall be provided for sump **containment** contents and other waste materials to be disposed of from the drilling activity. All sumps/ponds/**containments** shall **have** [be purged in a manner meeting with] the approval of the State Department of Health. In the event there are no DOH requirements, the applicant and the Planning Department shall request for guidelines from the DOH for the purging of sumps and ponds. Said guidelines shall be available to the community.

At the beginning of the mediation there were 6 parties in favor of the amendment 7 opposed and 4 took no position. As the result of the mediation the parties agreed that the Condition should be amended as follows:

15. All drilling mud solids and drill cuttings shall be discharged to and contained within [the well pad sump] **an impermeable containment area**. A disposal site or sites approved by the State Department of Health, prior to any disposal activity covered by this permit, shall be provided for sump **containment** contents and other waste materials to be disposed of from the drilling activity. All sumps/ponds/**containments** shall **have** [be purged in a manner meeting with] the approval of the State Department of Health. In the event there are no DOH requirements, the applicant and the Planning Department shall request for guidelines from the DOH for the purging of sumps and ponds. Said guidelines shall be available to the community.

The proposed amendments to Condition 16 are as follows:

16. All geothermal brines, steam condensate, and noncondensible gases produced during normal project operations shall be **disposed of in accordance with the State Department of Health Underground Injection Control permit requirements** [injected into the geothermal reservoir].

At the beginning of the mediation there were 8 parties in favor of the amendment 6 opposed and 3 parties who took no position. As the result of the mediation the parties agreed to amend Condition 16 as follows:

16. All geothermal brines, steam condensate, and noncondensible gases produced during [normal] project operations shall be **disposed of in accordance with the State Department of Health and Federal Underground Injection Control permit requirements** [injected into the geothermal reservoir].

The proposed amendments to Condition 17 are as follows:

17. Prior to commencing any activity approved under this Geothermal Resource Permit on the project site, the permittee shall submit **an air quality and meteorological monitoring program** to, and secure the approval of, **the State Department of Health Clean Air Branch, and shall comply with all NSP requirements and standards. All data and reports provided to the Clean Air Branch pursuant to the NSP shall be made available to the Planning Director for inspection upon request.** [the Planning Director of an air quality and meteorological monitoring program. The program shall include provisions for installation, calibration, maintenance and operation of recording instruments to measure air contaminant concentrations, the specific elements to monitored, the number of stations involved, and frequency of sampling and reporting. The Planning Director shall review and approve the submitted monitoring plan in consultation with and concurrence of the State Department of Health. The monitoring and sampling shall be conducted by a qualified contractor, and the samples analyzed by a qualified laboratory, selected by the permittee but subject to the approval of the Planning

Director. The selected contractor and laboratory shall operate under contract to, and shall be funded by the permittee. The program shall monitor the air quality immediately prior to, and during, all periods of well drilling, testing, production, and injection activity approved under this Geothermal Resource Permit. The data obtained shall be submitted to the Planning Director in accordance with the requirements contained in this Geothermal Resource Permit for submittal of all collected environmental monitoring data.]

At the beginning of the mediation there were 6 parties in favor of the amendment, 9 opposed and 2 who took no position. As the result of the mediation the parities agreed to the amendment to Condition 17 as proposed in reliance upon Collateral Agreement No. 1 referred to hereinafter.

The proposed amendments to Condition 18 are as follows:

18. The permittee shall apply "Best Available Control Technology" (BACT) for air emissions to all aspects of the project to minimize air quality impacts. BACT means the maximum degree of control for air quality concerns taking into account what is known to be practical and economically viable. BACT for each aspect of the project shall be **in accordance with applicable Federal and State regulations.** [determined by the Planning Director in consultation with other appropriate governmental agencies involved in the control or regulation of air quality from geothermal development projects. Such determination shall be made prior to issuance of any construction permit for that aspect of the project. BACT shall be subject to review by the Planning Director every five years, commencing with the date of approval of the Geothermal Resource Permit for the wellfield operations, and with the date of full power plant operation for the power plant.]

At the beginning of the mediation there were 6 parties in favor of the amendment 9 opposed and 2 who took no position. As the result of the mediation the parties agreed to amend Condition 18 as follows:

18. The permittee shall apply "Best Available Control Technology" (BACT), **as defined in Hawaii Administrative Rules 11-60.1-1 (as amended), and as applicable under Federal and State regulations and permits,** for air emissions to all aspects of the project to minimize air quality impacts. [determined by the Planning Director in consultation with other appropriate governmental agencies involved in the control or regulation of air quality from geothermal development projects. Such determination shall be made prior to issuance of any construction permit for that aspect of the project.] BACT shall be subject to review by the Planning Director every five years, commencing with the date of approval of the Geothermal Resource Permit for the wellfield operations, and with the date of full power plant operation for the power plant.

The proposed amendments to Condition 19 were as follows:

19: The permittee shall control all project emissions of hydrogen sulfide during normal power plant operation **in accordance to the State Department of Health Clean Air Branch regulations and NSP requirements** [so that the increase in the ambient

hydrogen sulfide concentration due to these project emissions shall not exceed 5 ppb at or beyond the project boundary].

At the beginning of the mediation there were 6 parties in favor of the amendment and 11 opposed. The positions of some of those opposing the amendment changed during mediation but there was no agreement.

The proposed amendment to Condition 21 is as follows:

21. **Except as otherwise provided for herein, the permittee shall comply with the Hawaii Administrative Rules Title 11, Chapter 46, Community Noise Control Program.** [Prior to commencing any activity approved under this Geothermal Resource Permit on the project site, the permittee shall submit to, and secure the approval of, the Planning Director of a noise monitoring program designed to adequately ensure project compliance with the noise impact limitations contained in this Geothermal Resource Permit. The program shall include the monitoring of noise immediately prior to and during all periods of activity approved under this Geothermal Resource Permit. The monitoring and sampling shall be conducted by a qualified contractor, and the samples analyzed by a qualified laboratory, selected by the permittee but subject to the approval of the Planning Director. The selected contractor and laboratory shall operate under contract to, and shall be funded by the permittee. This program should also allow the correlation of any complaints of noise from the public with the level of measured noise, the meteorological conditions, and the type of operations which occurred at the site.] The data obtained shall be **made available for inspection by** [submitted to] the Planning Director in accordance with the requirements contained in this Geothermal Resource Permit for submittal of all collected environmental monitoring data.

At the beginning of the mediation there were 5 parties in favor of the amendment and 12 opposed. There was no agreement reached in mediation.

The proposed amendments to Condition 22 are as follows:

22. The permittee shall apply "Best Available Control Technology" (BACT) for noise emissions to all aspects of the project to minimize project noise **in compliance with the Hawaii Administrative Rules Title 11, Chapter 46, Community Noise Control Program**. BACT means the maximum degree of control for noise concerns taking into account what is known to be practical and economically viable. [BACT for each aspect of the project shall be determined by the Planning Director in consultation with other appropriate governmental agencies involved in the control or regulation of noise from geothermal development projects. Such determination shall be made prior to issuance of any construction permit for that aspect of the project. BACT shall be subject to review by the Planning Director every five years, commencing with the date of approval of the Geothermal Resource Permit for the wellfield operations, and with the date of full power plant operation for the power plant.]

At the beginning of the mediation there were 4 parties in favor of the amendment and 13 opposed. There was no agreement reached in mediation.

The proposed amendments to Condition 23 are as follows:

23. The permittee shall **comply with** [notify the Planning Department and] **the State Department of Health Clean Air Branch (NSP) permit notice requirements prior to any geothermal well and pipeline cleanout utilizing geothermal steam.** [any resident within 3500 feet of the permittee's project boundary who has previously requested such notice, at least twenty-four (24) hours in advance of the open venting of each geothermal well and pipeline cleanout and 14 days before commencement of drilling. Initial notification to residents shall be made in writing, offering the opportunity to be placed on the notification list. Any other person may request to be on the list. The permittee shall notify the Planning Department immediately prior to the open venting of any geothermal well and pipeline cleanout. The permittee shall notify the Planning Department following completion of each geothermal well, prior to the demobilization of the drilling rig.]

At the beginning of mediation there were 6 parties in favor of the amendment and 11 opposed. As the result of mediation the parties agreed to amend Condition 23 as follows:

23. The permittee shall **comply with** [notify the Planning Department and] **the State Department of Health Clean Air Branch (NSP) permit notice requirements prior to any geothermal well and pipeline cleanout utilizing geothermal steam. Permittee shall also mail notice seventy-two (72) hours prior to such ativities to the Planning Director and to any resident of the District of Puna who submits their name and address to the Permittee requesting such notification. In addition thereto** any resident within 3500 feet of the permittee's project boundary who has previously requested such notice **shall be notified** at least [twenty-four (24) hours in advance of the open venting of each geothermal well and pipeline cleanout and] **14 days before commencement of drilling**. [Initial notification to residents shall be made in writing, offering the opportunity to be placed on the notification list. Any other person may request to be on the list. The permittee shall notify the Planning Department immediately prior to the open venting of any geothermal well and pipeline cleanout. The permittee shall notify the Planning Department following completion of each geothermal well, prior to the demobilization of the drilling rig.]

The proposed amendments to Condition 24 are as follows:

24. [Until such time as] **The permittee shall comply with** noise regulations [are] adopted by the State, [or County, the permittee shall comply with the following guidelines which shall be enforced by the Planning Department:

    a. During power plant and wellfield operations, the permittee shall not exceed a general noise level of 55 dBA during daytime and 45 dBA at night at the current nearest residence. For the purposes of these guidelines, "night" is defined as the hours between 7:00 p.m. and 7:00 a.m.;

b. The allowable noise levels may be exceeded by a maximum of 10 dBA; however, in any event, the generally allowed noise level should not be exceeded more than 10 percent of the time within any 20-minute period, and the permittee shall conduct all operations so as to minimize the occurrence, frequency, and duration of this impact noise;

c. The noise level guidelines specified above shall be waived only for the specified duration of authorized open geothermal well venting from all wells, steam pipeline cleanout periods, and the drilling and testing of wells from well pads E and F. During these authorized periods, BACT shall be applied. In addition, during the drilling and testing of wells from well pads E and F, the permittee shall meet a general noise level of 55 dBA during the day and 50 dBA during the night at the current nearest residence; and

d. For the purposes of these noise conditions, the "nearest residence" is hereby defined as: For three years following the date of granting of the Geothermal Resource Permit, that permanently occupied dwelling nearest the applicable noise emission point as of the date of the granting of this permit; for all following years, that permanently occupied dwelling nearest the applicable noise emission point.

e. Sound level measurements shall be conducted using standard procedures with sound level meters using the "A" weighting and "slow" meter response unless otherwise stated.]

At the beginning of mediation there were 6 parties in favor of the amendment and 11 opposed. No agreement on this condition was reached during mediation.

29. In the event the Hawaii County Civil Defense Agency determines that an emergency situation resulted from the permitted geothermal activity, the [permittee] **Geothermal Asset Fund and procedures contained at Rule 14 of the Planning Commission Rules** shall [bear all costs of evacuation] **be used and followed to reimburse claimants for the cost of evacuation; provided that should there be insufficient funds in the Asset Fund to pay for such costs, the permittee shall bear such costs.** The Hawaii County Civil Defense Agency shall be responsible for public and media notification and evacuation of members of the public in the event the Agency deems such action necessary as a result of an emergency situation.

At the beginning of mediation there were 4 parties in favor of the amendment, 10 opposed and 3 who took no position. No agreement on this condition was reached during mediation.

39. **In accordance with community notification requirements of the State Department of Health Noncovered Source Permit (NSP), the** [The] permittee shall notify each resident household within a radius of 3500 feet from any geothermal well at least twenty four (24) hours prior to[, and again the morning of,] any planned venting of **a geothermal well** [that well]. Each resident within this radius of 3500 feet shall be offered the opportunity to voluntarily leave the area during the well venting. The cost of such voluntary leaving, up to a maximum of $100.00 per resident or $200.00 per

household, whichever is lesser, shall be borne by the [permittee] **Geothermal Asset Fund pursuant to the procedures contained in Rule 14 of the Rules of the Planning Commission**. Upon adequate demonstration [to the permittee] that any such resident is unable to pursue his normal, legitimate employment or business activity as a result of such voluntary leaving, the [permittee] **Geothermal Asset Fund** shall reimburse that resident for that one day's lost income, in an amount not greater then $150.00, **pursuant to the procedures contained in Rule 14 of the Rules of the Planning Commission. In the event that there are insufficient funds in the Geothermal Asset Fund to pay for the cost of such voluntary leaving or loss of income, the permittee shall pay for such costs**.

At the beginning of mediation there were 4 parties in favor of the amendment, 9 opposed and 4 who took no position. No agreement on this condition was reached during mediation.

40. Upon adequate demonstration to the **Geothermal Asset Fund pursuant to the provisions of Rule 14 of the Rules of the Planning Commission,** [permittee] that any adverse alteration of the quality of the water has occurred as a result of venting to the atmosphere, the **Geothermal Asset Fund** [permittee] shall [immediately rinse the water catchment system and replace the] **bear the cost of rinsing the water catchment system and replacing the** stored water of any water catchment system within a radius of 3500 feet of any well. Upon adequate demonstration to the **Geothermal Asset Fund pursuant to the procedures contained in Rule 14 of the Rules of the Planning Commission** [permittee] that any agricultural crop damage resulted directly from any of the permittee's well venting operations, the **Geothermal Asset Fund** [permittee] shall also provide compensation to the owner of agricultural operations located within a radius of 3500 feet of that well. In either situation, compensation will only be considered if the agricultural crops and water catchment system are inventoried and registered with the **County Planning Department** [permittee] prior to the venting. Other requests shall be considered by the **Geothermal Asset Fund** [permittee] on a case-by-case basis.

At the beginning of mediation there were 4 parties in favor of the amendment, 9 opposed and 4 who took no position. No agreement on this condition was reached during mediation.

The proposed amendment would have removed Condition 48:

48. [The permittee shall secure all necessary approvals and clearances including Plan Approval pursuant to Chapter 25 of the Hawaii County Code, within one (1) year from the effective date of the Geothermal Resource Permit.]

At the beginning of mediation there were 4 parties in favor of the proposed amendment, 7 opposed and 6 who took no position. As the result of mediation it was agreed that Condition 48 should be deleted.

The proposed amendment to would have removed Condition 49.

49. [Construction shall commence within one (1) year from the date of receipt of Final Plan Approval.]

At the beginning of mediation there were 4 parties in favor of this amendment, 5 opposed and 8 who took no position. As the result of mediation it was agreed that Condition 49 should be amended as follows:

49. Construction shall commence within [one (1)] **two (2)** years from the date of receipt of Final Plan Approval.

Because Collateral Agreements were entered into as a part of this mediation Condition 50 of GRP2 must be amended. The parties have agreed to amend Condition 50 as follows:

50. The permittee shall submit a written semiannual status report to the Planning Commission through the Planning Director on the permittee's best efforts to address/comply with the "Other Agreements and Recommendations" as contained in Section 5 of the final report of the Mediator on the "Mediation Geothermal Resources Application 87-1 dated August 21, 1989, **and in Section 5 "Final Report" dated December 28, 2000, on the mediation of the proposed amendments to Conditions contained in the "Application For Amendment to Geothermal Resource Permit (87-1)**, regarding but not limited to the collateral agreements and commitments the permittee made during the mediation process, and which the permittee considers to be contractual obligations incident to the approval of permittee's amendments to GRP2. The status report shall be submitted by February 15 (covering the preceding period of July 1 through December 31) and August 15 (covering the preceding period of January 1 through July 30) of each year

The proposed amendment to Condition 51 was as follows:

51. Prior to the issuance of the first building/construction permit under this Geothermal Resources Permit (GRP) by the County of Hawaii, the State of Hawaii and the permittee shall each contribute towards a Geothermal Asset Fund or other appropriate existing fund for the purposes of geothermal impact mitigation efforts within the District of Puna. The permittee's initial contribution to the fund shall be a sum of $60,000, due within thirty (30) days after the effective date of this GRP permit, and annual sums of $50,000 due on or before the anniversary date of this GRP permit over a period of eight (8) consecutive years thereafter for a total of $460,000. Annual contributions thereafter shall be determined between the permittee and the State of Hawaii or $50,000 annually, whichever is greater. **In the event that the amount of the Fund reaches the sum of One Million Dollars ($1,000,000.00) or more, the permittee may discontinue making annual contributions; provided, however, that in the event that the amount of the Fund is depleted to an amount less than One Million Dollars ($1,000,000.00), permittee shall recommence to make annual contributions of up to $50,000.00 in order to replenish the Fund in an amount of One Million Dollars ($1,000,000.00).** The State's initial annual contribution to the Geothermal Asset Fund shall be the net revenues derived from the resources generated by the HGP-A Well, or a similar amount from other State funding sources less any allocations entitled to the Office of Hawaiian

Affairs and operations and maintenance costs. In the event that future enabling legislation provides for a percentage of the State's geothermal royalties to be allocated to the County, upon concurrence with the County Council, said royalties may also be deposited to the fund. The administration and expenditure of assets from this Geothermal Asset Fund shall be in accordance with rules, regulations, and procedures developed for that purpose by the County in accordance with Chapter 91, Hawaii Revised Statutes, and with participation of Puna residents or representatives thereof, which shall include, but not be limited to, provisions and criteria to enable the first priority of distribution for temporary or permanent relocation of those property owners who are found, in accordance with criteria established in the rules, to be adversely impacted by the activities authorized, provided that such relief is applied for within a period of one (1) year of the impact. A priority list of impact mitigation projects may be established by the County Council or agency designated by the Council in conjunction with Puna residents or designated representatives thereof, with the exception of upgrading existing subdivisions in the Puna District to current subdivision standards and specifications of the County of Hawaii. Should any other district(s) of the County of Hawaii be proved to be negatively impacted by activities authorized under this or any other subsequent GRP, that district shall receive a pro rata share of the fund assets as may be determined by the County Council or agency designated by the Council with expenditures to follow a prioritized schedule determined as outlined above. The rights granted to the permittee shall not be conditioned upon any contribution or further participation by the State in the fund nor with respect to the creation, management, and operation of the fund other than set forth above.

At the beginning of the mediation there were 5 parties in favor of this amendment, 7 opposed and 5 who took no position. No agreement was reached on this Condition.

Section 6 -- Collateral Agreement

Collateral agreements and commitments the permittee made during the mediation process, and which the permittee considers to be contractual obligations incident to the approval of Permittee's amendments to GRP2 are as follows:

1. Prior to any increase in power production, as proposed in the Permittee's Application for Amendment to GRP2 and in conjunction with the development of its air quality and meteorological monitoring program:
   a. The Permittee shall develop a protocol that will provide timely, accurate, and updated air quality monitoring information to surroundings residents. The protocol shall include provisions for surrounding residents to have access to real-time monitoring data. In addition, the Permittee shall use good faith efforts to develop an early notification system for surrounding residents.
   b. The Permittee shall broaden the range of measurements of H_2S emission levels from 0 to 20,000 ppb.
   c. The Permittee shall retain a consultant for the purpose of determining what amendments, if any, are required for Permittee's air quality monitoring program in relation to any increase in energy production. The Consultant shall evaluate onsite and offsite air quality and monitoring and the scope of work shall include

initial consultation with a work group consisting of the State Department of Health, County Planning Department, Community Representatives, and the Permittee. The Consultant shall present to the working group, for its review and input, any finding and recommendations that are developed as part of the consultant's work.

2. Within one year of the effective date of the Amendment to GRP2, the Permittee shall, in consultation with the Civil Defense Agency and other responding agencies, review the Permittee's Emergency Response Plan and develop revisions thereto, as may be appropriate. The Permittee shall report the status of such revisions to the Planning Commission, as required by Condition 50 of this permit.

Puna Malama Pono has offered its services to coordinate participation by the community in providing Community Representatives and working groups.

Thank you for giving me the opportunity to work with the parties and their issues. I regret that we were not able to resolve all of the issues but I believe that we reduced the number of disputed issues substantially.

Dated at Kailua-Kona, HI, December 30, 2000

COLIN L. LOVE, MEDIATOR

STATE OF HAWAII)
) SS:
COUNTY OF HAWAII)

On this 30day of December, 2000, before me personally appeared COLIN L. LOVE, to me known to be the person described in and who signed the foregoing instrument and who acknowledged that he signed the same as his free act and deed.

TERESA A. KUALAAU NOTARY PUBLIC STATE OF HAWAII

Notary Public, State of Hawaii
Print or type name
My commission expires: 10/24/2003

TERESA A. KUALAAU
Notary Public, Third Judicial Circuit
State of Hawaii

EXHIBIT "A"

	11/20/2000		12/1/2000		12/2/2000		12/5/2000		12/6/2000	
NAME	Sign in	Sign out	Sign in	Sign out	Sign in	Sign out	Sign in	Sign out	Sign in	Sign out
MR. JACK DEAN			8:45 AM	4:55 PM					12:00 AM	1:45 PM
MS. MARLENE DYKEMA	9:00 AM	12:10 PM								
MR. JIM RICE	9:00 AM	1210 PM			9:00 AM	3:15 PM				
MS. KATE T. HARRISON			9:00 AM	10:30 AM	1:50 PM	2:30 PM				
MS. PAULA Z. HELFRICH	9:15 AM	12:00 PM								
MS. LUANA JONES	9:00 AM	12:10 PM	9:08 AM	11:30 AM	9:00 AM	2:30 PM			9:00 AM	10:30 AM
MR. STEVE MOYNIHAN										
MS. DIANNA MOYNIHAN										
MR. DELAN PERRY										
MS. JENNIFER PERRY					9:15 AM	2:00 PM				
MR. STEVE PHILIPS										
MS. RENE SIRACUSA	9:00 AM	12:10 PM	8:48 AM	11:28 AM	8:57 AM	1:30 PM			9:00 AM	1:00 PM
MR. AL DETTWEILER	9:00 AM	12:10 PM	9:03 AM	11:28 AM	8:57 AM	4:00 PM			9:00 AM	2:05 PM
MS. ANNIE SZVETECZ	9:00 AM	12:10 PM	9:04 AM	11:28 AM	9:00 AM	3:20 PM			9:00 AM	1:40 PM
MR. ROBERT A KOCHY	9:00 AM	12:10 PM	8:50 AM	11:30 AM	9:00 AM	12:00 PM				
MS. AURORA MARTINOVICH	9:00 AM	12:10 PM	9:02 AM	11:28 AM	10:20 AM	3:20 PM				
MS. ATHENA PEANUT	10:10 AM	12:10 PM	8:55 AM	11:28 AM	9:08 AM	3:15 PM			9:00 AM	2:10 PM
MR. DONALD M. THOMAS	9:00 AM	12:10 AM								
MR. GENE THOMAS	9:00 AM	12:10 AM	9:15 AM	11:30 AM						
PLANNING DEPARTMENT	9:00 AM	12:10 AM	8:46 AM	4:55 AM	9:00 AM	3:20 PM	9:44 AM	6:30 PM	9:05 AM	2:05 PM
PUNA GEOTHERMAL VENTURE	9:00 AM	12:10 AM	8:46 AM	4:55 AM			9:41 AM	6:30 PM	2:30 PM	

EXHIBIT "A"

	12-18-00		12-19-00							
NAME	Sign in	Sign in	Sign in	Sign out	Sign out	Sign out	Sign out	Sign out	Sign out	Sign out
MR. JACK DEAN										
MS. MARLENE DYKEMA										
MR. JIM RICE	9:00 AM	7:00 PM	9:30 AM	11:30 AM						
MS. KATE T. HARRISON										
MS. PAULA Z. HELFRICH										
MS. LUANA JONES										
MR. STEVE MOYNIHAN										
MS. DIANNA MOYNIHAN										
MR. DELAN PERRY										
MS. JENNIFER PERRY	3:00 PM	7:02 PM								
MR. STEVE PHILIPS	8:50 AM									
MS. RENE SIRACUSA										
MR. AL DETTWEILER	8:50 AM	7:00 PM	8:55 AM	12:30 PM						
MS. ANNIE SZVETECZ	8:55 AM	5:15 PM	9:15 AM	12:10 PM						
MR. ROBERT A KOCHY	9:10 AM	5:50 PM								
MS. AURORA MARTINOVICH	9:20 AM	7:03 PM	9:15 AM	12:15 PM						
MS. ATHENA PEANUT	9:25 AM	7:00 PM	9:15 AM	12:15 PM						
MR. DONALD M. THOMAS										
MR. GENE THOMAS	9:20 AM	7:00 PM								
PLANNING DEPARTMENT	4:50 PM	6:00 PM								
PUNA GEOTHERMAL VENTURE	8:57 AM	7:00 PM	9:30 AM	12:15 PM						

CERTIFICATE OF SERVICE

I hereby certify that the original and ten copies of the foregoing document was served by certified mail on the 30th day of December, 2000, on:

PLANNING DEPARTMENT
25 AUPUNI STREET
HILO, HI 96720

I hereby certify that a true and correct copy of the foregoing document was served by certified mail on the 30th day of December 2000, on:

MR. JACK DEAN
P O BOX 4333
HILO, HI 96720

MS. KATE T HARRISON
13-3410 LUANA STREET
PAHOA, HI 96778

MS. LUANA JONES
P O BOX 2092
PAHOA, HI 96778

DELAN AND JENNIFER PERRY
P 0 BOX 537
PAHOA, HI 96778

MS. RENE SIRACUSA
MALAMA O PUNA
P O BOX 1520
PAHOA, HI 96778

MS. ANNIE SZVETECZ
PUNA MALAMA PONO
HCR1 BOX 5281
KEAAU, HI 96749

MS. AURORA MARTINOVICH
13-3997 HONUA ULA ROAD
PAHOA, HI 96778

MR. GENE THOMAS
P O BOX 2065
PAHOA, HI 96778

MS. MARLENE DYKEMA
MR. JIM RICE
P O BOX 2139
PAHOA, HI 96778

MS. PAULA Z. HELFRICH
HAWAII ISLAND ECONOMIC
DEVELOPMENT BOARD
200 KANOELEHUA AVENUE
HILO, HI 96720

STEVE AND DIANNA MOYNIHAN
P O BOX 2025
PAHOA, HI 96778

MR. STEVE PHILIPS
13-3451 KUPONO STREET
PAHOA, HI 96778

MR. AL DETTWEILER
PUNA MALAMA PONO
P O BOX 263
PAHOA, HI 96778

MR. ROBERT A KOCHY
P O BOX 1097
PAHOA, HI 96778

MR. DONALD M. THOMAS
104 KOULA STREET
HILO, HI 96720

MR BARRY MIZUNO
PUNA GEOTHERMAL VENTURE
C/O R. BEN TSUKAZAKI, ESQ.
100 PAUAHI STREET SUITE 204
HILO, HI 96720

Colin L. Love, Arbitrator

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O.BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD/SDWB

April 12, 2002

04005UCH.02

To
Andy
Mondeen

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawai`i 96778

Dear Mr. Mizuno:

SUBJECT: PUNA GEOTHERMAL VENTURE (PGV)
UNDERGROUND INJECTION CONTROL (UIC)
UIC PERMIT APPLICATION NO. UH-1529A

Pursuant to your letter, dated March 18, 2002, you are hereby granted a 180-day time extension for the approval to construct up to seven (7) injection wells at the subject facility. This extension expires on October 18, 2002.

This extension is conditioned on the restrictions and requirements as stipulated in our October 24, 2001 letter to you for the granting-of-approval to construct up to seven injection wells. If construction is expected to occur after October 18, 2002, you are required to ask in writing for a time extension at least 30 days before expiration.

The granting of a time extension may require from you information to evaluate current injection well plans, situations, or other circumstances which may affect the granting of a time extension. In this regard, you are advised to inform us about any such matters at the earliest possible time.

If you have any questions about this subject, please call Chauncey Hew of the Safe Drinking Water Branch (SDWB) at 586-4258 or call direct toll free from Big Island at 974-4000, ext. 64258.

Sincerely,

GARY GILL, DEPUTY DIRECTOR
Environmental Health Administration

CH:chl

c: 1. Environmental Health Specialist, SDWB, East Hawaii
2. Mr. Christopher Yuen, Director, Planning Department, Hawaii County
3. Mr. Gil S. Coloma-Agaran, Chairman, DLNR
4. Dr. Seiji Naya, Director, DBEDT
5. Ms. Laura Tom Bose, Chief, Ground Water Office USEPA, Region 9

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O.BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD/SDWB

February 14, 2002 02003UCH.02

The Honorable Harry Kim
Mayor, County of Hawai'i
25 Aupuni Street, Room 215
Hilo, Hawai'i 96720-4252

ATTENTION: Lincoln S. T. Ashida, Esq.

Dear Mayor Kim:

Thank you for expressing the concerns and ideas in a letter dated January 7, 2002, from Mr. Lincoln Ashida. We share mutual concerns and similarly believe in the responsible and safe development of geothermal energy in Hawai'i County.

The information that was previously transmitted to you represents the final stages of two Underground Injection Control application processes: (1) UIC permit renewal to operate three injection wells and (2) construction (or conversion) of up to seven new injection wells. The UIC applications for these two activities were initiated by Puna Geothermal Venture (PGV) in June 1995 and August 1997, respectively.

The granting of the renewed UIC permit and the approval-to-construct letter allows PGV to continue using their injection wells, KS-1A, KS-3, and KS-4, and further prepare for replacing or supplementing their injection capacity should the existing injection wells become inadequate.

At the present time, PGV is conducting a long-term injection test on KS-10 which was originally a production well. If the test results are favorable, PGV may opt to restructure and reclassify KS-10 into an injection well. Should this occur, PGV will consequently use one of the seven well-allotments granted by the approval-to-construct letter in establishing a fourth injection well. Once a well-allotment is used, it is not recoverable.

Our current understanding through communication with PGV is that well-drilling activities are not presently scheduled or expected in the near future. However, should PGV decide to embark on any well-drilling activity, all proper notifications must be made to the appropriate agencies which, at the State level, are principally the Department of Land and Natural Resources (DLNR) and the Department of Health. Upon such notification, the internal programs begin a network of planning and coordination to address regulatory requirements including health, safety, and environmental concerns. The most recent past event was the drilling of the production well KS-11 which took approximately three months and ended in December 1999 without any incidents.

Your proposal to establish an expert consultant to monitor health and safety concerns especially during drilling is an idea that deserves discussion among agencies should PGV decide to drill again. The merit of having such a person doing an effective job to restore public trust is unquestionable. If this approach is satisfactory to you, we will keep your proposal ready and bring it forward if drilling is proposed. We will also inform the DLNR about your proposal via a copy of this letter and your initial letter.

May we also recommend that Hawai'i County's Geothermal Resource Permit be reexamined at the appropriate time for opportunities to implement your proposal. Perhaps under item No. 23 or another relevant item, conditions may be imposed upon PGV to fund an expert consultant.

Please inform us of your thoughts about this subject at your earliest convenience. We look forward to using the best available options to insure safety at and public trust in PGV.

For any questions about the UIC permit or construction of injection wells, please call Chauncey Hew of the Safe Drinking Water Branch at 586-4258 (Honolulu).

Sincerely,

BRUCE S. ANDERSON, Ph.D., M.P.H.
Director of Health

c: Mr. Andrew Monden, Chief Engineer (w/letter dated January 7, 2002)
Land Division, Engineering Branch
Department of Land & Natural Resources
P.O. Box 373
Honolulu, HI 96809

Harry Kim
Mayor

Lincoln S.T. Ashida
Corporation Counsel

Gerald Takase
Assistant Corporation Counsel

DOEH

County of Hawaii

OFFICE OF THE CORPORATION COUNSEL

101 Aupuni Street, Suite 325 • Hilo, Hawaii 96720-4262 • (808) 961-8251 • FAX (808) 961-8622

January 7, 2002

Dr. Bruce S. Anderson
Director of Health
State Department of Health
P.O. Box 3378
Honolulu, HI 96801-3378

Dear Dr. Anderson:

RE: **Puna Geothermal Venture**
Underground Injection Control (UIC)
Proposed State UIC Permit Renewal,
UIC Permit No. UH-1529, and
Proposed Construction of New Injection Wells

Thank you for your letter to Hawai'i County Mayor Harry Kim of December 5, 2001, concerning the approval of Puna Geothermal Venture's applications for the renewal of permits to operate three injection wells, and for the construction of seven new injection wells.

Mayor Kim continues to support the responsible development of geothermal energy in Hawai'i County.

As you know, Mayor Kim, while Civil Defense Director for our County, expressed concern for the health and safety of nearby residents in the Puna area. This was a result of disputed information concerning unacceptable health risks, the blowout of the KS-8 well, as well as concern over the degree and vigilance of health and safety monitoring in the area.

As a result, controversy within our community ensued, with our citizens having limited faith in our government leaders as well as the private industry representatives of Puna Geothermal Venture.

Mayor Kim understands the series of events leading to this public distrust were unintentional. However, the negative fallout permeates to this day.

In the interest of fostering a working relationship between our local County government, the State, and Puna Geothermal Venture, and with an eye towards the development of responsible geothermal development on our island, the County of Hawai'i proposes that the State and/or Puna Geothermal Venture retain an expert consultant for the purpose of monitoring health and safety concerns at the Kapoho site. This consultant would be invaluable during the drilling period of the new injection wells, as he or she would be accountable to both the County and State. We firmly believe the use of such an expert consultant would address health and safety concerns expressed by the public, and pave the way towards the restoration of the public trust in both government as well as Puna Geothermal Venture.

Our County invites you or your designated representative to contact us for the purpose of scheduling a meeting to discuss the aforementioned concerns.

Together, we believe geothermal energy may continue to serve for our citizens.

Please call me at (808) 961-8304, extension 26, so we may schedule a mutually convenient day and time to begin discussions. We look forward to hearing from you.

Very truly yours,

LINCOLN S. T. ASHIDA
Corporation Counsel

cc: Mayor Harry Kim
Chris Yuen, Planning Director

S: Departments/Mayor/LSA Misc. Correspondence/Letter re PGV 12-31-01/LSAmr

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*** TX REPORT ***
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BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O.BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD/SDWB

February 14, 2002 02003UCH.02

The Honorable Harry Kim
Mayor, County of Hawai'i
25 Aupuni Street, Room 215
Hilo, Hawai'i 96720-4252

Post-it® Fax Note 7671	Date 2/21/02	# of pages ▶ 4
To Eric Tanaka	From Nami Wong	
Co./Dept. DLNR-Land-Eng	Co. DLNR-Land-Eng	
[redacted]		

For your information.

ATTENTION: Lincoln S. T. Ashida, Esq.

Dear Mayor Kim:

Thank you for expressing the concerns and ideas in a letter dated January 7, 2002, from Mr. Lincoln Ashida. We share mutual concerns and similarly believe in the responsible and safe development of geothermal energy in Hawai'i County.

The information that was previously transmitted to you represents the final stages of two Underground Injection Control application processes: (1) UIC permit renewal to operate three injection wells and (2) construction (or conversion) of up to seven new injection wells. The UIC applications for these two activities were initiated by Puna Geothermal Venture (PGV) in June 1995 and August 1997, respectively.

The granting of the renewed UIC permit and the approval-to-construct letter allows PGV to continue using their injection wells, KS-1A, KS-3, and KS-4, and further prepare for replacing or supplementing their injection capacity should the existing injection wells become inadequate.

At the present time, PGV is conducting a long-term injection test on KS-10 which was originally a production well. If the test results are favorable, PGV may opt to restructure and reclassify

Harry Kim
Mayor

County of Hawaii

PLANNING COMMISSION

25 Aupuni Street, Room 109 • Hilo, Hawaii 96720-4252
(808) 961-8288 • Fax (808) 961-8742

CERTIFIED MAIL
7000 0600 0024 2904 6488

Mr. Barry T. Mizuno
Puna Geothermal Venture
P.O. Box 30
Pahoa, HI 96778

Dear Mr. Mizuno:

Geothermal Resource Permit (GRP 2)
Applicant: Puna Geothermal Venture
Request: Amendment to Permit
Tax Map Key: 1-4-1:portion 2, 3, portion 19 and 58

The Planning Commission at its duly held public hearing on January 19, 2000, voted to approve the request for an amendment to Geothermal Resource Permit No. 2 (GRP 2) to allow an increase of generation of electrical power up to 60 MW of electrical capacity, and amendments to related conditions. The property is located on the eastern portion of the Kilauea East Rift Zone, Kapoho Section of the Geothermal Resource Subzone. The project site is located near the junction of the Pahoa-Kapoho and Pahoa-Pohoiki Roads, and adjacent to (north) Lanipuna Gardens Subdivision, Kapoho, Puna, Hawaii.

Approval of this request is based on the following:

Puna Geothermal Venture (PGV) is requesting the amendment to the permit to develop and operate a 60 MW geothermal power project consisting of multiple power generating units, up to 30 geothermal wells drilled within the subject property, brine and steam pipelines, pollution control equipment, steam separators, production and injection wells, related wellfield equipment, holding ponds, switch yards, office buildings, workshops, control buildings, access roads, and auxiliary facilities such as air compressors, and fire protection equipment, all in a manner consistent with applicable

regulatory standards and permits utilizing new technology and equipment upgrades. PGV is also requesting the amendments to incorporate regulatory standards and permit requirements that have been promulgated and issued since the permit was originally approved. When GRP No. 2 was approved in 1989, the Island of Hawaii consumed a peak of 130 MW of electrical energy. Consumption since then has steadily increased to a peak of 170 MW in 1999. With the anticipated growth of the Island population, it is expected that the peak requirement will increase approximately 3-4 MW each year.

On October 3, 1989, the Planning Commission approved GRP No. 2 (87-1) for the Puna Geothermal Venture Project, described as generating 25 MW of electrical energy from geothermal fluids produced from the Puna Geothermal field. The project consisted of the following:

- ten (10) integrated back-pressure steam turbines and air-cooled binary cycle turbine power generating modules;
- up to 30 geothermal wells drilled from six (6) wellpads;
- brine and steam pipelines;
- pollution control equipment;
- a brine surge tank and holding pond;
- a switchyard;
- an office, warehouse, workshop, and control buildings
- access roads; and
- auxiliary facilities such as air compressors and fire protection equipment.

The project was approved subject to 50 conditions (the permit indicates 51; however, due to a numbering error, there are actually 50 conditions). The applicant is requesting that 21 of the 50 conditions be amended. The primary reason for the amendments is to incorporate regulatory standards and permit requirements that have been promulgated and issued since the permit was originally approved in 1989. Of the 21 amendments requested, the majority (12) are necessary to incorporate current regulatory standards (Condition Nos. 6, 7, 10, 16-19, 21-24, and part of 39), three pertain to the Geothermal Asset Fund (Condition Nos. 29, 40 and 51), one is proposed to be deleted because the condition is no longer relevant (Condition No. 13), and five relate to proposed uses (Condition Nos. 1, 4, 15, 17, 48 and 49). However, the Planning Commission recommends that Condition Nos. 29, portion of 39, 40 and 51 pertaining to the

Geothermal Asset Fund be retained as stated in the permit. The Planning Commission also recommends that Condition Nos. 48 and 49 pertaining to Final Plan Approval and commence construction be retained but clarified to reflect the requested amendment.

In accordance with Section 205-5.1(e), Hawaii Revised Statutes, and Section 12-6 of the Planning Commission Rule 12, the approval of the amendments is based upon the following findings:

The proposed geothermal development activities would not have unreasonable adverse health, environmental, or socio-economic effects on residents or surrounding properties. PGV has been in operation since 1989, and occupies approximately 25 acres within a 500-acre project area located in the Kapoho Section of the Kilauea Lower East Rift Geothermal Resource Subzone. Each drill site is engineered to support the drilling equipment to keep drilling effluent contained on site, separate from any natural drainage. Each well pad has drilling mud pits, and sumps with sloped walls are used to temporarily store drilling wastes. The high porosity of the volcanic soils and rock in the site area results in rapid downward percolation of rainwater. Concrete pads and berms contain possible spills in areas where chemicals are handled. Catch basins, culverts, ditches, and berms are provided for drainage control. There are no surface streams or ponds in the vicinity of the drill sites, and groundwater is protected by cementing casing into the hole to depths below sea level.

The project provides a dependable source of electricity and reduces Hawaii's dependency on imported fuel for greater energy self-sufficiency. PGV has been a reliable source of alternative energy since 1989, and also provides employment opportunities for residents, leading to positive personal income and public revenues.

The applicant has taken measures to protect the environment, such as clearing vegetation to prevent fires, incorporating a landscaping program to minimize soil erosion around the perimeter of the property, cementing production and injection well casings into the ground to depths below sea level, well below the potable water table. In addition, the site is several miles from the ocean, therefore, there is no impact to marine life. PGV has developed strict operating, environmental, and safety procedures to ensure the facility is operating safely and in compliance with regulations. An Environmental/Safety Manager is on site to monitor the facility and to ensure that environmental compliance is maintained. The applicant has developed an Emergency Response Plan, which outlines procedures for dealing with any potential emergencies. The applicant has established an internal Incident Command System, and four incident commanders have been trained to coordinate mitigation response as required in an emergency. PGV has also interfaced with the County Police, Fire, Hazardous Materials emergency responder to coordinate training and to familiarize these outside responders with the facility.

The development of the facility has resulted in a number of positive socio-economic impacts on the Island of Hawaii, including 1) the elimination of rolling blackouts, 2) public awareness of the project through contributions and participation in community activities, 3) financial contributions to the Reading is Fundamental Program at Keonepoko School, and 4) payment of royalties to the State of Hawaii in excess of $3 million, which is distributed to the County of Hawaii and the Office of Hawaiian Affairs (OHA).

This project supports the following goals and policies of the General Plan:

Energy Element

* Strive towards energy self-sufficiency for Hawaii County.

* Establish the Big Island as a demonstration community for the development and use of natural energy resources.

* The County shall encourage the development of alternate energy resources.

* The County shall strive to assure a sufficient supply of energy to support present and future demands.

* The County shall encourage the development of geothermal resources to meet the energy needs of the County of Hawaii.

The economic benefits and security implications of reducing Hawaii's dependence on imported fuels for energy production have been recognized for a long period of time at all levels of government. This has resulted in a general policy of support for alternative energy research and development.

Economic Element

* Provide residents with opportunities to improve their quality of life.

* Economic development and improvement shall be in balance with the physical and social environments of the island of Hawaii.

* The County of Hawaii shall strive for diversity and stability in its economic system.

* The County shall provide an economic environment which allows new, expanded, or improved economic opportunities that are compatible with the County's natural and social environment.

* The County of Hawaii shall strive for an economic climate which provides its residents an opportunity for choice of occupation.

Land Use Element

* Designate and allocate land uses in appropriate proportions and mix and in keeping with the social, cultural and physical environments of the County.

* The County shall encourage the development and maintenance of communities meeting the needs of its residents in balance with the physical and social environment.

The proposed geothermal development activities would not unreasonably burden public agencies to provide roads and streets, sewers, water, drainage, school improvements, and police and fire protection. The existing project and proposed amendments have a negligible impact on public infrastructure and services. There are approximately 30 employees on the site, and no additional County services will be required. The employees are mostly Big Island residents, and the increased production capabilities will not require additional personnel, therefore adverse housing impacts are not anticipated. Traffic may increase slightly during construction phases, but the added vehicles do not significantly add to the existing high traffic levels at the intersection of Pahoa-Kapoho Road and Pahoa-Pohoiki Road. No additional infrastructure is necessary to accommodate the applicant's request, since the proposed use will be confined to the existing facility, and the applicant is requesting the amendments to incorporate regulatory standards and permit requirements that have been promulgated and issued since the permit was originally approved in 1989.

There are reasonable measures available to mitigate the unreasonable adverse effects or burdens referred to above. Mitigation measures have been established to ensure the integrity of the geothermal wells. Hydrogen Sulfide (H_2S) monitors are located in three locations at the project site. Emergency procedures have been established for dealing with any potential emergencies. Although the project is located more than 2,000 feet from Lanipuna Gardens and Pohoiki Bay Estates, and more than 3,400 feet from Leilani Estates, there are residences within a half-mile of the project site. Due to the relative proximity of the residences to the project area, the applicant has employed the most effective air and noise emission measures available, following strict standards of the Department of Health. The applicant has been and will continue to comply with all applicable regulations regarding environmental monitoring.

PGV currently utilizes three geothermal injection wells (KS-1A, KS-3 and KS-4) with a pending application for an additional well. All steam, brine and condensate generated from production wells are injected into these three injection wells at a depth of

between 3,900 and 7,300 feet. These three wells are authorized and permitted by the State Department of Health's Safe Drinking Branch. PGV also holds the State Underground Injection Permit (UH-1529) authorizing the operation of the injection wells. Air emissions are monitored by the use of H_2S and particulate matter devices. In the event the H_2S concentrations exceed the ambient air standard of 25 ppb on an hourly average basis (regulated by the State Department of Health Clean Air Branch), PGV has developed written safety procedures to mitigate any adverse health effects to the community. At the request of the State Department of Health, a monitoring station has been established at the western property boundary to monitor fugitive emissions to this area. The facility is currently permitted as a Noncovered Source Facility. The Geothermal Compliance Specialist from the State Department Health is on site daily to monitor compliance with emission standards.

Noise emissions are controlled by the use of noise abatement materials and sound engineering controls. PGV is operating with a noise permit issued by the State Department of Health Noise and Radiation Branch. PGV is classified as a Class C facility, which allows the facility to operate at a maximum level of 70 dBA, measured 24 hours a day at the property boundary. Noise is monitored by use of noise microphone devices installed at the property boundaries at Monitoring Stations A and B. An alarm system is installed in the Control Room for early detection to allow prompt action if required. The noise alarm setpoint for early warning detection is set at 65 dBA. The measurements obtained at the monitoring stations have all been within the parameters of health, workplace and other standards relating to short or long term exposure to H_2S or noise levels. Drilling muds and other wastes not reinjected are disposed of pursuant to the State Department of Solid Waste regulations. Sewage disposal is by cesspool, in accordance with the State Department of Health rules.

In the original Geothermal Resource Permit, the permittee agreed "not exceed a general noise level of 55 dBA during the daytime [7am to 7pm] and 45 dBA at night [7pm to 7 am] measured at the nearest residence." This general noise level could be exceeded by up to 10 dBA, but not for more than 10% of the time within any 20 minute period. There was also an exception for periods of venting and drilling. These standards applied only until noise regulations were adopted by the State or County. Because the DOH adopted regulations in 1996, those now apply, and the permittee is allowed to emit up to 70dBA, 24 hours per day. This is unreasonably loud and the Planning Commission believes that nearby residents are justified in seeking a stricter standard. It is also understandable that they did not expect that noise standards would be so drastically relaxed, after the permittee made representations that the noise levels would not exceed 55/45 dBA.

The permittee's noise monitoring records show that it has generally run below 55dBA during the day, but because it is a baseload facility, and runs 24 hours per day, it is not much quieter at night. While the facility itself does not greatly vary from hour to

hour in the amount of noise it emits (except for unusual events, such as steam leaks), atmospheric and wind conditions significantly affect the noise levels in the community, and to some extent, also affect the readings at the monitors.

The permittee has stated that it does not expect its increase in power generation to result in a significant increase in noise, but wants some regulatory leeway in the setting of standards. The permittee also believes that it should not be regulated more strictly than other facilities in the agricultural district.

The residents have asked that the noise levels not increase, and want the permittee to seek ways to reduce the noise impact from the facility. For these reasons, the Commission recommends that the permittee hire a qualified engineering consultant to review the present operations, as well as to advise on engineering the Best Applicable Control Technology (BACT) into new equipment to be installed at the plant.

The proposed noise levels have generally been achieved by the permittee during the January-June 2000 period. They are not meant to imply that these are levels which are "desireable" in an area like this. They have been set at a level which the facility should be able to meet, in recognition of the fact that it provides an important community benefit, and is legally operating under a much more lenient standard. At the same time, the BACT requirement means that feasible noise reduction measures must be implemented, unless the facility substantially complies with residential noise standards.

The Department does not wish to mislead the community about the purposes and level of its enforcement of the noise condition. Its role is to ensure that the facility generally runs within the permitted levels. It may spot-check the data it receives from the permittee for reliability, and it may require actual measurements of noise levels at residences, but it does not have the capability to respond to individual complaints on a daily basis.

With regards to liability, the Commission recommends that the permittee shall keep in force a general liability policy with limits of not less than $25 million per occurrence, and shall furnish the Planning Department with a certificate of insurance annually.

The Planning Director has withdrawn the previous recommendation that the Geothermal Asset Fund be capped at $1,000,000. It became clear from the mediation that no one is happy with the present Geothermal Asset Fund. The surrounding community is frustrated that only $1,800 in claims have been paid from the fund. The permittee is unhappy that it contributes $50,000 annually to a fund that has not been put to any practical use. The Director notes that the present rules make the Planning Commission function like an insurance claims manager, a role completely unlike its other responsibilities. There is, however, nothing close to a consensus about what to do about

the Fund. The Fund is a major opportunity, and the Planning Department plans to hold further discussions with the affected community about its use. A change in the rules for the fund does not have to be tied to this permit. The rules can be changed at any time. At present, however, because there is no agreement, and because the annual contribution was a result of the prior mediation, the Department does not support any reduction in the amount contributed by the permittee. The Department is willing to consider the suggestion of some community members that the opportunity for owners to participate in a voluntary buy-out program be re-opened, and perhaps expanded to a wider geographical area, and perhaps include some who built after the original permit was granted, but this requires further study, and it does not have to be tied to this permit.

The Planning Commission is comfortable with H_2S levels presently set by the State Department of Health, but to ensure that these are kept, Condition No. 17 is amended so that the permittee will not ask to increase the levels.

Based on the above, the request to amend Geothermal Resource Permit No. 2 (87-1) is consistent with the criteria contained in Section 12-6 of the Planning Commission Rule 12 and Chapter 205-5.1(e), Hawaii Revised Statutes, and the following conditions are hereby amended and renumbered accordingly (material to be deleted is bracketed, material to be added is underscored).

1. The Geothermal Resource Permit grants approval for those uses and improvements described in the "Geothermal Resource Permit Application Amendment for the Puna Geothermal Venture Project," dated March 1989, except as amended, modified, or conditioned by this Geothermal Resource Permit. Except as otherwise described in this permit, no other uses are authorized by this permit[,]. **The following uses are allowed under this Geothermal Resource Permit: turbines, generators, air coolers fans, air compressors, diesel driven pumps and motors, production wells, injection wells, steam separators and accumulators, electrical transformers, control valves, rock mufflers, H_2S abatement equipment, welding machines, drilling rigs and auxiliary equipment, designed and operated for the generation of up to 60 MW of geothermal power** and any proposed other uses of the geothermal resource or improvements to the land, whether to be conducted by the permittee or a third-party under contract to, or other agreement with, the permittee, shall be subject to prior review and approval, consistent with the applicable Rules of Practice and Procedure of the Hawaii County Planning Commission. The Planning Director may, upon written request of the permittee, approve deviations from the project layout and uses permitted under this Geothermal Resource Permit if such amendments are consistent with the uses permitted and conditions of this Geothermal Resource Permit. No action pursuant to any such request for deviation by the permittee shall be taken without the written approval of the Planning Director. Amendments to the Geothermal Resource Permit and its

conditions may be granted pursuant to Article 12-9 of the Rules of Practice and Procedure of the County of Hawaii Planning Commission.

2. The permittee, its successors, or assigns shall be responsible for complying with all of the stated conditions of approval of this Geothermal Resource Permit. Should the Planning Director determine that there is noncompliance with the Geothermal Resource Permit or its conditions, the permittee may be subject to enforcement of the Geothermal Resource Permit conditions and penalties pursuant to Sections 12-10 and 12-11 of Rule 12 of the Rules of Practice and Procedure of the County of Hawaii Planning Commission.

3. The permittee shall grant unrestricted access to the subject property(ies) to authorized governmental representatives or to consultants or contractors hired by governmental agencies for inspection, enforcement, or monitoring of activities subject to or authorized by this Geothermal Resource Permit. A designated employee shall be available at all times for purposes of supplying information and responses deemed necessary by the authorized governmental representative in connection with such work.

4. During the [period] **periods** of construction [of the project,] or during the drilling or testing of any well, the permittee shall submit a weekly written status report to the Planning Department which shall include:

   a. A brief description of the work undertaken during the previous week under the Geothermal Resource Permit;

   b. A description of the work being proposed during the next week under the Geothermal Resource Permit; and

   c. Any other information that the Planning Department may reasonably require which addresses the immediate environmental and regulatory concerns of the County of Hawaii or the requirements of the Geothermal Resource Permit.

5. The permittee shall submit a written semiannual status report to the Planning Department by February 15 (covering the preceding period of July 1 through December 31) and August 15 (covering the preceding period of January 1 through June 30) of each year. The status report shall include, but not be limited to:

   a. A brief summary of work undertaken during the current reporting period under the Geothermal Resource Permit;

b. A brief summary of work being proposed over the next reporting period under the Geothermal Resource Permit;

c. The results and analysis of all environmental monitoring activities undertaken as required by this Geothermal Resource Permit;

d. A log of any complaints received by the project and the responses thereto; and

e. Any other information that the Planning Department may reasonably require which addresses the environmental and regulatory concerns of the County of Hawaii or the requirements of the Geothermal Resource Permit.

6. If any environmental monitoring data collected as required under this Geothermal Resource Permit indicates [that] **the** project operations are creating, or have the immediate potential of creating, excessive health or environmental effects not otherwise permitted by this Geothermal Resource Permit, the permittee shall [submit such data to the Planning Department within 48 hours of its identification.] **comply with the State of Hawaii Clean Air Branch Noncovered Source Permit (NSP) reporting requirements, and provide immediate notice to the Department of Health, provide immediate notice to the Planning Director and provide a copy of any report(s) to the Planning Department simultaneously with the Department of Health.**

7. **The permittee shall comply with the Clean Air Branch, Safe Drinking Water Branch, and Department of Noise and Radiation Branch of the Department of Health's recordkeeping requirements.** The permittee shall maintain [a record] **records** in a permanent form suitable for inspection**, regarding noise, hydrogen sulfide emissions, equipment upsets, and any other sampling or analytical results,** and shall make such record available on request to the Planning Director or his designee. [The record shall include:

a. Occurrence and duration of any start-up, shut-down, and operation mode of each geothermal well and/or facility;

b. Performance testing, evaluation, calibration checks, and adjustment and maintenance of the continuous monitor(s) that have been installed; and

c. All measurements reported in units compatible with applicable standards/guidelines.]

8. Prior to the commencement of any grubbing or grading activity, the permittee shall:

a. Submit a metes and bounds description of all lands to be disturbed including but not limited to all roadways, well pads, steam gathering system corridors, injection system corridors, power plant site, and transmission line corridors to Planning Director;

b. Mark the boundaries of these sites to be disturbed in the field; and

c. Comply with all requirements of Chapter 10 Erosion and Sedimentation Control, Hawaii County Code (the County grading ordinance).

9. No construction or transportation equipment shall be permitted beyond the prescribed boundaries of the areas to be disturbed.

10. Prior to commencing any geothermal well drilling, testing, production, or injection activity approved under this Geothermal Resource Permit, the permittee shall submit [to, and secure the approval of, the Planning Director of] a hydrologic monitoring program **to the State Safe Drinking Water Branch. Semi-annual testing shall be performed in accordance with the Hydrological Monitoring Program (HMP) which is described in the Hawaii State Underground Injection Control (UIC) permit. In addition thereto testing of the same wells shall be done within three (3) months after the permittee submits its Well Completion Report to the Department of Land and Natural Resources and after any event that may cause permittee's activities to contaminate the ground water. All data and reports submitted to the Safe Drinking Water Branch shall be submitted to the Planning Director**. [The program shall, at a minimum, provide for the quarterly monitoring of water levels and appropriate chemical species from existing wells completed within the shallow aquifer in those areas downgradient of the project area, including the Green Lake water supply, as well as from a well located within the project boundary and completed within the shallow aquifer. The monitoring, sampling, and analysis protocols shall be clearly defined in the program submitted to and approved by the Planning Director. The monitoring and sampling shall be conducted by a qualified contractor, and the samples analyzed by a qualified laboratory, selected by the permittee but subject to the approval of the Planning Director. The selected contractor and laboratory shall operate under contract to, and shall be funded by the permittee. The program shall monitor the shallow groundwater immediately prior to, and during, all periods of well drilling, testing, production, and injection activity approved under this Geothermal Resource Permit. The data obtained shall be submitted to the Planning Director in accordance with the requirements contained in this Geothermal Resource Permit for submittal of all collected environmental monitoring data. The County shall make random checks of the ground water supply no less than every two months.]

11. If pollution of the shallow ground water is demonstrated to be occurring from the project construction, operation or maintenance activities as determined by the Planning Director in consultation with the Department of Water Supply and the Department of Land and Natural Resources, the permittee shall immediately take those measures necessary to eliminate the source of the pollution meeting with the approval of the affected agencies. If any geothermal production or injection well demonstrates that the integrity of the well casing is lost such that the shallow groundwaters are being, or may immediately be polluted by the production or injection activity of that well, the permittee shall, as quickly as practical consistent with safety and prudent operating practices, cease the production or injection activity for that well, and the activity not resume for that well until adequate casing integrity is restored to the satisfaction of the Department of Land and Natural Resources.

[13. In the event the Department of Water Supply determines that the existing Green Lake county water source becomes contaminated by the permittee's geothermal wellfield system, the permittee shall immediately provide alternative(s) to the water supply, including the hauling of water if necessary as a temporary alternative, which meet the approval of the County's Department of Water Supply and the State Department of Health.

14.]12. Only nonhazardous drilling mud additives, as recognized on the "California Department of Health Services Drilling Mud Additives Use in Nonhazardous Drilling Muds and Fluids" list, shall be used during the drilling of the geothermal wells, and which list shall be on file with the County Planning Department.

[15.]13. All drilling mud solids and drill cuttings shall be discharged to and contained within [the well pad sump] **an impermeable containment area**. A disposal site or sites approved by the State Department of Health, prior to any disposal activity covered by this permit, shall be provided for sump **containment** contents and other waste materials to be disposed of from the drilling activity. All sumps/ponds/**containments** shall [be purged in a manner meeting with] **have** the approval of the State Department of Health. In the event there are no DOH requirements, the applicant and the Planning Department shall request for guidelines from the DOH for the purging of sumps and ponds. Said guidelines shall be available to the community.

[16.]14. All geothermal brines, steam condensate, and noncondensible gases produced during [normal] project operations shall be [injected into the geothermal reservoir] **disposed of in accordance with the State Department of Health and Federal Underground Injection Control permit requirements**.

[17.]15. Prior to commencing any activity approved under this Geothermal Resource Permit on the project site, the permittee shall submit **an air quality and meteorological monitoring program** to, and secure the approval of, [the Planning Director of an air quality and meteorological monitoring program. The program shall include provisions for installation, calibration, maintenance and operation of recording instruments to measure air contaminant concentrations, the specific elements to monitored, the number of stations involved, and frequency of sampling and reporting. The Planning Director shall review and approve the submitted monitoring plan in consultation with and concurrence of the State Department of Health. The monitoring and sampling shall be conducted by a qualified contractor, and the samples analyzed by a qualified laboratory, selected by the permittee but subject to the approval of the Planning Director. The selected contractor and laboratory shall operate under contract to, and shall be funded by the permittee. The program shall monitor the air quality immediately prior to, and during, all periods of well drilling, testing, production, and injection activity approved under this Geothermal Resource Permit. The data obtained shall be submitted to the Planning Director in accordance with the requirements contained in this Geothermal Resource Permit for submittal of all collected environmental monitoring data.] **the State Department of Health Clean Air Branch, and shall comply with all NSP requirements and standards. All data and reports provided to the Clean Air Branch pursuant to the NSP shall be made available to the Planning Director for inspection.**

[18.]16. The permittee shall apply "Best Available Control Technology" (BACT), **as defined in Hawaii Administrative Rules 11-60.1-1 (as amended), and as applicable under Federal and State regulations and permits,** for air emissions to all aspects of the project to minimize air quality impacts. BACT means the maximum degree of control for air quality concerns taking into account what is known to be practical and economically viable. BACT for each aspect of the project shall be [determined by the Planning Director in consultation with other appropriate governmental agencies involved in the control or regulation of air quality from geothermal development projects. Such determination shall be made prior to issuance of any construction permit for that aspect of the project. BACT shall be subject to review by the Planning Director every five years, commencing with the date of approval of the Geothermal Resource Permit for the wellfield operations, and with the date of full power plant operation for the power plant.] **in accordance with applicable Federal and State regulations.**

[19.]17. The permittee shall control all project emissions of hydrogen sulfide during [normal] power plant operation [so that the increase in the ambient hydrogen sulfide concentration due to these project emissions shall not exceed 5 ppb at or beyond the project boundary] **in accordance with the State Department of Health Clean Air Branch regulations and NSP requirements**. **The permittee**

shall comply with all provisions of the applicable NSP, and shall not request any increase in the levels of hydrogen sulfide allowed under the existing NSP. If the allowed levels of hydrogen sulfide are increased from those allowed under the present NSP, the permittee shall continue to meet the standards in the present NSP.

[20.]18. With regard to air emissions, the permittee shall submit to the County Civil Defense and the Planning Department a map and accompanying text that describes predetermined "worst case" impacted areas.

[21.]19. [Prior to commencing any activity approved under this Geothermal Resource Permit on the project site, the permittee shall submit to, and secure the approval of, the Planning Director of a noise monitoring program designed to adequately ensure project compliance with the noise impact limitations contained in this Geothermal Resource Permit. The program shall include the monitoring of noise immediately prior to and during all periods of activity approved under this Geothermal Resource Permit. The monitoring and sampling shall be conducted by a qualified contractor, and the samples analyzed by a qualified laboratory, selected by the permittee but subject to the approval of the Planning Director. The selected contractor and laboratory shall operate under contract to, and shall be funded by the permittee. This program should also allow the correlation of any complaints of noise from the public with the level of measured noise, the meteorological conditions, and the type of operations which occurred at the site. The data obtained shall be submitted to the Planning Director in accordance with the requirements contained in this Geothermal Resource Permit for submittal of all collected environmental monitoring data.]

The permittee shall hire a qualified engineering consultant to study noise from its existing and proposed operations. The scope of work shall include:

a. Determination of sound levels in the surrounding community due to the permittee's operations, and correlation of those sound levels to levels recorded at the monitoring sites on permittee's property.

b. Identification of specific sources of noise from the plant site.

c. Recommendation and evaluation of noise abatement methods, including possible tree planting and/or berm construction, engineering design sketches and specifications and/or catalog cut sheets, and cost estimates for the determination of feasibility and best available control technology.

d. Study of other ambient noise in the community and at the permittee's monitoring stations to determine the effect of ambient noise on the monitoring system.

e. Preparation of a final report and recommended noise abatement procedures.

f. The consultant shall meet at least twice with nearby residents, and with the Planning Director as required. The consultant's final report and recommendations shall be a public document available to the Planning Director and the general public.

[22.]20. The permittee shall apply "Best Available Control Technology" (BACT) for noise emissions to all aspects of the project to minimize project noise. BACT means the maximum degree of **noise** control [for noise concerns] taking into account what is [known to be] practical and economically [viable] **reasonable**. BACT [for each aspect of the project] shall be determined by the Planning Director [in consultation with other appropriate governmental agencies involved in the control or regulation of noise from geothermal development projects. Such determination shall be made prior to issuance of any construction permit for that aspect of the project. BACT shall be subject to review by the Planning Director every five years, commencing with the date of approval of the Geothermal Resource Permit for the wellfield operations, and with the date of full power plant operation for the power plant.] **upon the recommendations of the noise consultant.**

[23.]21. The permittee shall [notify the Planning Department and] **comply with the State Department of Health Clean Air Branch (NSP) permit notice requirements prior to any geothermal well and pipeline cleanout utilizing geothermal steam. Permittee shall also mail notice seventy-two (72) hours prior to activities to the Planning Director and to any resident of the District of Puna who submits their name and address to the permittee requesting such notification. In addition thereto** any resident within 3500 feet of the permittee's project boundary who has previously requested such notice, **shall be notified** at least [twenty-four (24) hours in advance of the open venting of each geothermal well and pipeline cleanout and] 14 days before commencement of drilling. [Initial notification to residents shall be made in writing, offering the opportunity to be placed on the notification list. Any other person may request to be on the list. The permittee shall notify the Planning Department immediately prior to the open venting of any geothermal well and pipeline cleanout. The permittee shall notify the Planning Department following completion of each geothermal well, prior to the demobilization of the drilling rig.]

[24.]22. [Until such time as noise regulations are adopted by the State or County, the permittee shall comply with the following guidelines which shall be enforced by the Planning Department:

a. During power plant and wellfield operations, the permittee shall not exceed a general noise level of 55 dBA during daytime and 45 dBA at night at the current nearest residence. For the purposes of these guidelines, "night" is defined as the hours between 7:00 p.m. and 7:00 a.m.;

b. The allowable noise levels may be exceeded by a maximum of 10 dBA; however, in any event, the generally allowed noise level should not be exceeded more than 10 percent of the time within any 20-minute period, and the permittee shall conduct all operations so as to minimize the occurrence, frequency, and duration of this impact noise;

c. The noise level guidelines specified above shall be waived only for the specified duration of authorized open geothermal well venting from all wells, steam pipeline cleanout periods, and the drilling and testing of wells from well pads E and F. During these authorized periods, BACT shall be applied. In addition, during the drilling and testing of wells from well pads E and F, the permittee shall meet a general noise level of 55 dBA during the day and 50 dBA during the night at the current nearest residence; and

d. For the purposes of these noise conditions, the "nearest residence" is hereby defined as: For three years following the date of granting of the Geothermal Resource Permit, that permanently occupied dwelling nearest the applicable noise emission point as of the date of the granting of this permit; for all following years, that permanently occupied dwelling nearest the applicable noise emission point.

e. Sound level measurements shall be conducted using standard procedures with sound level meters using the "A" weighting and "slow" meter response unless otherwise stated.]

The permittee shall report average noise levels for each hour, and shall report a daily average and a monthly average. Except as allowed below:

a. The average for any month shall not exceed 54 dBA;

b. The average for any day shall not exceed 57 dBA;

c. The average for any hour shall not exceed 62 dBA;

d. The average for any five-minute period shall not exceed 68 dBA.

The allowable noise levels may be exceeded, at each monitoring station, by no more than 3 dBA, for the following periods: five months per year for the monthly average; five days per month for the daily average; and five hours per month for the hourly average.

During specified steam pipeline cleanout periods, construction, and testing of wells, BACT shall be applied and the allowed noise levels may be exceeded by not more than 5 dBA. During specified periods of drilling, the permittee shall comply with Department of Health's noise rules and permit requirements.

Averaging shall be done in a manner consistent with the reporting of noise data by the permittee in the January-June 2000 period. The monthly average shall be the arithmetic mean of the daily averages. The daily average shall be the arithmetic mean of the hourly averages.

The new allowable noise levels shall take effect six months after the installation of any additional generating equipment.

Noise levels shall be measured at the present monitoring stations A and B, which shall be averaged separately, and not combined. The location of the monitoring stations may be changed with the approval of the Planning Director, if recommended by the noise consultant, to make the noise level at the monitoring stations more reliably correlate with the noise levels at the nearby residences. If the location is changed, the allowed levels may be adjusted accordingly.

Data from periods in which the noise monitoring includes significant amounts of noise from sources other than the permittee's operations, such as agricultural operations, rain, wind, and traffic, shall be excluded.

The Director, using the recommendations of the consultant, shall establish standard adjustments for the effects of ambient noise on the data reported from the monitoring stations. For example, if the consultant determines that a typical daily average of 51 dBA would be 49 dBA eliminating the effect of ambient noise, the lower figure shall be considered the actual noise level. The Director, using the recommendation of the consultant, shall establish

standard adjustments for the difference between the data reported from the monitoring stations and the noise levels due to the permittee's geothermal operations at the most affected residences, so that the allowed noise levels are not exceeded at the residences which are, on the average, the most affected by noise. The purpose of the standard adjustments is to ensure that the allowed noise levels experienced at residences due to the permittee's geothermal operations are not exceeded.

Sound level measurements shall be conducted using standard procedures with sound level meters using the "A" weighting and "slow" meter response unless otherwise stated. The method of measurement shall follow H.A.R. §11-46-9.

The permittee shall have an alarm system which alerts staff if the noise level exceeds 68 dBA for more than 5 minute average.

The permittee shall record and respond to all complaints of excessive noise and forward a record of such complaints to the Planning Director monthly, along with monitoring records showing the noise levels recorded at the time of the complaint. All noise monitoring records shall be furnished monthly to the Planning Director. The permittee shall explain any exceedances of the authorized noise levels.

Before any enforcement action is taken on violations the permittee shall be given a reasonable opportunity to cure any violations. An exceedance shall not be considered a violation unless the measured noise level is more than 3 dBA above the ambient or background noise level, per H.A.R. §11-46(9) (g) and (h).

The permittee shall be conclusively deemed to be using BACT, and be in compliance with all noise standards, if the noise level solely due to its geothermal operations, at the most affected residences, substantially complies with the current State Department of Health standards for "Class A" (residential) districts. For the purposes of this paragraph, the permittee substantially complies with the standards if:

a. The average hourly noise levels do not exceed 55 dBA during the day (7:00 a.m. to 10:00 p.m.) and 45 dBA at night (10:00 p.m. to 7:00 a.m.) more than 10% of the time with the day and night hours separately considered, and

b. During those hours when the noise levels are exceeded, the average exceedance is not more than 5 dBA, and the average

hourly noise level never exceeds 60 dBA days and 55 dBA nights. Periods of steam pipeline cleanout, construction, well drilling, and highly unusual events shall be excluded and the standard adjustments referred to above shall apply.

If the consultant determines that a significant reduction in noise levels can be achieved, at a reasonable cost, by a vegetative screen and/or earthen berm, the permittee shall set aside an area or areas for such a screen and/or berm. The location of the vegetative screen and/or earthen berm, if recommended, shall be agreed upon between the Planning Director and the permittee, and shall not unduly interfere with the permittee's power transmission easements, access, and other aspects of the permittee's operations, and may be relocated for operational reasons to an equivalent location. The Geothermal Asset Fund may be used for the cost of planting and maintaining the vegetative screen and/or constructing the earthen berm. For the purposes of this paragraph, a "significant reduction" means one of 3 dBA or more.

[25.]23. Pursuant to Article 12-8 of the Rules of Practice and Procedure of the County of Hawaii Planning Commission, prior to initiating construction of the project, the permittee shall submit the following to the Planning Director:

a. Copies of approved permits and other applicable approvals for the project from other county, state, or federal agencies as applicable;

b. Final plans or provisions for monitoring environmental effects of the project as required by this Geothermal Resource Permit or otherwise required to ensure compliance with County rules and the rules of the State Department of Health and Board of Land and Natural Resources and other permit-issuing agencies;

c. A final plan of action to deal with emergency situations which may threaten the health, safety, and welfare of the employees and other persons in the vicinity of the proposed project site; and

d. A final site plan and elevations of proposed temporary and/or permanent structures for the project.

[26.]24. Prior to commencing any activity approved under this Geothermal Resource Permit on the project site, the permittee shall submit to, and secure the approval of, the Hawaii County Civil Defense Director a final plan of action to deal with emergency situations which may threaten the health, safety, and welfare of the

employees and other persons in the vicinity of the proposed project site. The plan shall include but not be limited to, the following elements:

a. A description of the project facilities and operations, with site plans identifying areas of potential hazards, such as high pressure piping and the presence, storage and transportation of flammable or hazardous materials, such as lubrication or fuel oil, isopentane, hydrogen sulfide, and sodium hydroxide;

b. A description of emergency services available off-site to respond to any emergency;

c. A description of the current onsite chain of command and responsibilities of project personnel in the event of an emergency; and

d. A description of potential project emergency situations, such as loss of well control, chemical spills, hydrogen sulfide exposure, pipeline rupture, fires, contaminated solids, etc. identifying:

   (i) technical data on the nature of the hazard (for example, the concentrations of hydrogen sulfide in the various areas and the hazard associated with these concentrations, the corrosive characteristics of the abatement chemicals), or any data regarding the possible aerial extent of each potential emergency situation;

   (ii) the warning systems (such as hydrogen sulfide detectors) used to alert personnel of the hazard;

   (iii) the location and use of equipment used to control the hazard (such as fire protection equipment or isolation valves) or repair hazardous equipment (such as welding equipment or casing sleeves), and safety equipment for personnel (such as respiratory packs), including identification of the personnel trained in the use of that equipment; and

   (iv) provisions for the monitoring, detection, and inspection of wells and plant facilities for the prevention of emergency situations.

e. Provisions to address natural hazards (such as lava flows, earthquakes, and storms) that identify warning systems, control options, steps for securing and shutting down the facility, personnel evacuation, and notification to appropriate agencies;

f. The location and capabilities of available medical services and facilities and plans for treating and transporting injured persons;

g. Evacuation plans, including meeting points, personnel rosters, and escape routes;

h. Training requirements for personnel, including procedures for emergency shutdown, handling of emergency equipment, spill prevention, first aid and rescue, fire fighting procedures, and evacuation training;

i. Provisions for periodic emergency preparedness drills for personnel;

j. Detailed procedures to be used to facilitate coordination with appropriate federal, state, and county officials during and after any emergency situation; and

k. Procedures to be used to identify and inform all residents within applicable distances of the project of the possible emergency situations, warnings, and responses in advance of commencement of project operations and the methods by which all individuals affected by a given emergency will be notified and evacuated, as necessary.

Copies of the emergency plan shall be made available to the public by the applicant.

[27.]25. Reports and records of emergency situations shall be submitted to the Planning Department upon occurrence of such emergencies.

[28.]26. Within 48 hours after an earthquake registering 6 or above on the Richter Scale and/or within 48 hours after an eruption has occurred, all wells within 10 kilometers of the epicenter or eruptive center, shall be examined for any physical changes which would alter its downhole integrity. A report of this examination shall be filed with the Planning Department within 48 hours of the examination.

[29.]27. In the event the Hawaii County Civil Defense Agency determines that an emergency situation resulted from the permitted geothermal activity, the permittee shall bear all costs of evacuation. The Hawaii County Civil Defense Agency shall be responsible for public and media notification and evacuation of members of the public in the event the Agency deems such action necessary as a result of an emergency situation.

[30.]28. Prior to the commencement of any surface disturbing activity, the permittee shall conduct an archaeological survey of those areas planned for surface disturbance

not previously surveyed and submit the results of this survey to the Planning Department for review and approval.

[31.]29. If construction activities expose any cultural remains, the permittee shall immediately cease work in the area of the cultural remains and contact the Planning Department and the State Historic Preservation Office. As appropriate, a qualified archaeologist shall be retained by the permittee to implement any necessary mitigation measures and monitor further work. Work in the affected area shall not resume until such time that clearance is obtained from the Planning Department.

[32.]30. The lighting used shall not interfere with the operations at the observatories located on Mauna Kea. To meet this requirement, the permittee shall comply with the requirements of Chapter 14, Article 9 of the Hawaii County Code, relating to outdoor lighting.

[33.]31. All lights shall be at a minimum level consistent with the safety of operations and shall be shielded or directed away from surrounding residential or populated areas and not interfere with important biological resources in the area.

[34.]32. The permittee shall submit to, and secure the approval of the Planning Director of a detailed landscaping and siting plan. The siting plan shall show plan and elevational views of all proposed temporary and/or permanent structures for the project. The plan shall also show the site topography, natural features and proposed berms, planting schedules, tree sizes, heights (actual size of trees to be planted), type of irrigation system, etc. Installation of approved landscaping improvements shall be commenced within three weeks from the completion of construction of each well pad, access road, or other facility. The plan shall also include:

a. A landscaping maintenance program;

b. A line-of-sight analysis, being especially sensitive to views from surrounding residences, of the view planes from the site property lines, from the intersection of Leilani Avenue and the Pahoa-Pohoiki Road, for the intersection of the proposed access road and the Pahoa-Kapoho Road, from the intersection of Lauone Street and Hinalo Street in Lanipuna Gardens, and the intersection of the Kapoho-Kalapana Road and the access road to Vacationland; and

c. To the extent possible, the well sites and power plant shall be landscaped and sited to reflect the existing agricultural character of the area, and utilize native plantings.

[35.]33. To the extent compatible with engineering and aesthetic considerations, all exterior surfaces shall be rough texture, with no reflective metal, and no reflective glass surfaces oriented toward surrounding residential or populated areas within line of sight. The exterior of all project structures, including fluid conveyance pipelines, shall be painted in colors so as to blend in with the surrounding environment.

[36.]34. The permittee shall submit and secure approval of a revegetation/site reclamation plan meeting with the approval of the Planning Director in consultation with the Forestry Division of the Department of Land and Natural Resources. When construction is completed on any individual project site, or if the project area is abandoned, all denuded areas on and around the project site shall be revegetated in accordance with this plan. Said plan shall include appropriate security to assure its implementation in a timely manner.

[37.]35. The permittee shall obtain and maintain those bonds required for project operations by the rules and regulations of the Board of Land and Natural Resources and the Department of Health.

[38.]36. The permittee shall obtain and maintain builder's risk and comprehensive liability insurance for project construction and operation activities**, with a limit of not less than $25 million per occurrence**.

[39.]37. **In accordance with community notification requirements of the State Department of Health Noncovered Source Permit (NSP), the** [The] permittee shall notify each resident household within a radius of 3500 feet from any geothermal well at least twenty four (24) hours prior to[, and again the morning of,] any planned venting of [that well] **a geothermal well**. Each resident within this radius of 3500 feet shall be offered the opportunity to voluntarily leave the area during the well venting. The cost of such voluntary leaving, up to a maximum of $100.00 per resident or $200.00 per household, whichever is lesser, shall be borne by the permittee. Upon adequate demonstration [to the permittee] that any such resident is unable to pursue his normal, legitimate employment or business activity as a result of such voluntary leaving, the permittee shall reimburse that resident for that one day's lost income, in an amount not greater than $150.00.

[40.]38. Upon adequate demonstration to the permittee that any adverse alteration of the quality of the water has occurred as a result of venting to the atmosphere, the permittee shall immediately rinse the water catchment system and replace the stored water of any water catchment system within a radius of 3500 feet of any well. Upon adequate demonstration to the permittee that any agricultural crop

damage resulted directly from any of the permittee's well venting operations, the permittee shall also provide compensation to the owner of agricultural operations located within a radius of 3500 feet of that well. In either situation, compensation will only be considered if the agricultural crops and water catchment system are inventoried and registered with the permittee prior to the venting. Other requests shall be considered by permittee on a case-by-case basis.

[41.]39. The permittee shall establish and publish a telephone number for use by local individuals for the lodging of complaints or inquiries regarding status of operations. A designated representative of the permittee shall be available, 24 hours a day, to respond to any local complaints or inquiries.

[42.]40. Large vehicle deliveries to the project site shall be limited to daylight hours. For the purposes of this condition, daylight hours is defined as the hours between 7:00 a.m. and 7:00 p.m. This condition shall not apply for vehicles responding to emergencies.

[43.]41. An extension of time for the performance of conditions within the permit may be granted by the Planning Director upon the following circumstances: 1) the non-performance is the result of conditions that could not have been foreseen or are beyond the control of the applicants, successors, or assigns and that are not the result of their fault or negligence; 2) granting of the time extension would not be contrary to the General Plan or Zoning Code; 3) granting of the time extension would not be contrary to the original reasons for the granting of the Geothermal Resource Permit; and 4) the time extension granted shall be for a period not to exceed one (1) year and 5) if the applicant should require an additional extension of time, the Planning Director shall submit the applicant's request to the Planning Commission for appropriate action.

[44.]42. All other applicable rules, regulations, and requirements, including those of the State Department of Health and the State Department of Land and Natural Resources shall be complied with.

[45.]43. The permittee shall obtain, and comply with the provisions of, permits to drill, modify use or abandon, as appropriate, from the State Board of Land and Natural Resources for each geothermal well approved under this Geothermal Resource Permit.

[46.]44. The permittee shall obtain and comply with the provisions of, Underground Injection Control Permits, as appropriate, from the State Department of Health for all geothermal injection wells approved under this Geothermal Resource Permit. A copy of the UIC Permit and any conditions shall be available in the County Planning Department.

[47.]45. The permittee shall obtain, and comply with the provisions of, Authorities to Construct and Permits to Operate from the State Department of Health for all applicable project operations approved under this Geothermal Resource Permit.

[48.]46. The permittee shall secure [all necessary approvals and clearances including] **Final** Plan Approval pursuant to Chapter 25 of the Hawaii County Code, [within one (1) year from the effective date of the Geothermal Resource Permit] **prior to each incremental increase in power production.**

[49.]47. Construction shall commence within [one (1) year] **two (2) years** from the date of receipt of Final Plan Approval **for each incremental increase in power production**.

[50.]48. The permittee shall submit a written semiannual status report to the Planning Commission on the permittee's best efforts to address/comply with the "Other Agreements and Recommendations" as contained in Section 5 of the final report on "Mediation of Geothermal Resource Permit Application 87-1" dated August 21, 1989, **and in Section 5 "Final Report" dated December 30, 2000, on the mediation of the proposed amendments to conditions contained in the "Application For Amendment to Geothermal Resource Permit (87-1),"** regarding but not limited to the collateral agreements and commitments the permittee made during the mediation process, and which the permittee considers to be contractual obligations subject to the issuance of a satisfactory Geothermal Resource Permit. This status report shall be submitted by February 15 (covering the preceding period of July 1 through December 31) and August 15 (covering the preceding period of January 1 through June 30) of each year.

[51.]49. Prior to the issuance of the first building/construction permit under this Geothermal Resources Permit (GRP) by the County of Hawaii, the State of Hawaii and the permittee shall each contribute towards a Geothermal Asset Fund or other appropriate existing fund for the purposes of geothermal impact mitigation efforts within the District of Puna. The permittee's initial contribution to the fund shall be a sum of $60,00, due within thirty (30) days after the effective date of this GRP permit, and annual sums of $50,000 due on or before the anniversary date of this GRP permit over a period of eight (8) consecutive years thereafter for a total of $460,000. Annual contributions thereafter shall be determined between the permittee and the State of Hawaii or $50,000 annually, whichever is greater. The State's initial annual contribution to the Geothermal Asset Fund shall be the net revenues derived from the resources generated by the HGP-A Well, or a similar amount from other State funding sources less any allocations entitled to the Office of Hawaiian Affairs and operations and maintenance costs. In the event that future enabling legislation provides for a percentage of the State's geothermal royalties to be allocated to the County, upon

concurrence with the County Council, said royalties may also be deposited to the fund. The administration and expenditure of assets from this Geothermal Asset Fund shall be in accordance with rules, regulations, and procedures developed for that purpose by the County in accordance with Chapter 91, Hawaii Revised Statutes, and with participation of Puna residents or representatives thereof, which shall include, but not be limited to, provisions and criteria to enable the first priority of distribution for temporary or permanent relocation of those property owners who are found, in accordance with criteria established in the rules, to be adversely impacted by the activities authorized, provided that such relief is applied for within a period of one (1) year of the impact. A priority list of impact mitigation projects may be established by the County Council or agency designated by the Council in conjunction with Puna residents or designated representatives thereof, with the exception of upgrading existing subdivisions in the Puna District to current subdivision standards and specifications of the County of Hawaii. Should any other district(s) of the County of Hawaii be proved to be negatively impacted by activities authorized under this or any other subsequent GRP, that district shall receive a pro rata share of the fund assets as may be determined by the County Council or agency designated by the Council with expenditures to follow a prioritized schedule determined as outlined above. The rights granted to the permittee shall not be conditioned upon any contribution or further participation by the State in the fund nor with respect to the creation, management, and operation of the fund other than set forth above.

50. Upon termination of the operations or abandonment of any portion of the affected site, the land shall be graded to blend with the surrounding areas and revegetated. Further, the site shall be left in a nonhazardous condition. A plan for compliance with this condition shall be submitted to the Planning Director for review and approval within ninety (90) days from the date of termination or abandonment, and upon completion of the plan, notice of completion shall be given to the Planning Director.

This approval does not, however, sanction the specific plans submitted with the application as they may be subject to change given specific code and regulatory requirements of the affected agencies.

Should you have any questions, please contact Alice Kawaha of the Planning Department at 961-8288.

Sincerely,

Geraldine M. Giffin, Chairman
Planning Commission

Lpgvgrp2pc

cc: Department of Public Works
Department of Water Supply
County Real Property Tax Division
Department of Land and Natural Resources
Kazu Hayashida, Director/DOT-Highways, Honolulu
Department of Health
Civil Defense Agency
Department of Business, Economic Development & Tourism
Mr. Jack Dean
Ms. Annie Szvetecz
Mr. Robert Kochy
Mr. Al Dettweiler
Diane and Steve Moynihan
Jennifer and Delan Perry
Mr. Steve Philips
Ms. Aurora Martinovich
Ms. Kate T. Harrison
Ms. Paula Z. Helfrich
Mr. Donald M. Thomas
Mr. Gene Thomas
Ms. Athena Peanut
Ms. Luana Jones
Ms. Marlene Dykema & Mr. Jim Rice
Ms. Rene Siracusa
Colin Love, Esq.
R. Ben Tsukazaki, Esq.

[47.]145. The permittee shall obtain, and comply with the provisions of, Authorities to Construct and Permits to Operate from the State Department of Health for all applicable project operations approved under this Geothermal Resource Permit.

[48.]146. The permittee shall secure [all necessary approvals and clearances including] **Final** Plan Approval pursuant to Chapter 25 of the Hawaii County Code, [within one (1) year from the effective date of the Geothermal Resource Permit] **prior to each incremental increase in power production.**

[49.]147. Construction shall commence within [one (1) year] **two (2) years** from the date of receipt of Final Plan Approval **for each incremental increase in power production**.

[50.]148. The permittee shall submit a written semiannual status report to the Planning Commission on the permittee's best efforts to address/comply with the "Other Agreements and Recommendations" as contained in Section 5 of the final report on "Mediation of Geothermal Resource Permit Application 87-1" dated August 21, 1989, **and in Section 5 "Final Report" dated December 30, 2000, on the mediation of the proposed amendments to conditions contained in the "Application For Amendment to Geothermal Resource Permit (87-1)."** regarding but not limited to the collateral agreements and commitments the permittee made during the mediation process, and which the permittee consider to be contractual obligations subject to the issuance of a satisfactory Geotherm Resource Permit. This status report shall be submitted by February 15 (coveri the preceding period of July 1 through December 31) and August 15 (coverin preceding period of January 1 through June 30) of each year.

[51.]149. Prior to the issuance of the first building/construction permit under this Geothermal Resources Permit (GRP) by the County of Hawaii, the State of Hawaii and the permittee shall each contribute towards a Geothermal Asse or other appropriate existing fund for the purposes of geothermal impact mitigation efforts within the District of Puna. The permittee's initial con to the fund shall be a sum of $60,00, due within thirty (30) days after the date of this GRP permit, and annual sums of $50,000 due on or before t anniversary date of this GRP permit over a period of eight (8) consecut thereafter for a total of $460,000. Annual contributions thereafter sha determined between the permittee and the State of Hawaii or $50,000 whichever is greater. The State's initial annual contribution to the Ge Asset Fund shall be the net revenues derived from the resources gene HGP-A Well, or a similar amount from other State funding sources allocations entitled to the Office of Hawaiian Affairs and operation maintenance costs. In the event that future enabling legislation pro percentage of the State's geothermal royalties to be allocated to th

concurrence with the County Council, said royalties may also be deposited to the fund. The administration and expenditure of assets from this Geothermal Asset Fund shall be in accordance with rules, regulations, and procedures developed for that purpose by the County in accordance with Chapter 91, Hawaii Revised Statutes, and with participation of Puna residents or representatives thereof, which shall include, but not be limited to, provisions and criteria to enable the first priority of distribution for temporary or permanent relocation of those property owners who are found, in accordance with criteria established in the rules, to be adversely impacted by the activities authorized, provided that such relief is applied for within a period of one (1) year of the impact. A priority list of impact mitigation projects may be established by the County Council or agency designated by the Council in conjunction with Puna residents or designated representatives thereof, with the exception of upgrading existing subdivisions in the Puna District to current subdivision standards and specifications of the County of Hawaii. Should any other district(s) of the County of Hawaii be proved to be negatively impacted by activities authorized under this or any other subsequent GRP, that district shall receive a pro rata share of the fund assets as may be determined by the County Council or agency designated by the Council with expenditures to follow a prioritized schedule determined as outlined above. The rights granted to the permittee shall not be conditioned upon any contribution or further participation by the State in the fund nor with respect to the creation, management, and operation of the fund other than set forth above.

50. Upon termination of the operations or abandonment of any portion of the affected site, the land shall be graded to blend with the surrounding areas and revegetated. Further, the site shall be left in a nonhazardous condition. A plan for compliance with this condition shall be submitted to the Planning Director for review and approval within ninety (90) days from the date of termination or abandonment, and upon completion of the plan, notice of completion shall be given to the Planning Director.

This approval does not, however, sanction the specific plans submitted with the application as they may be subject to change given specific code and regulatory requirements of the affected agencies.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT COLOMA-AGARAN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
JANET E. KAWELO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:LD/WL-EK

DEC 19 2001

Mr. Russell M. Gifford, Vice President
Barnwell Geothermal Corporation
1100 Alakea Street, Suite 2900
Honolulu, Hawaii 96813

Dear Mr. Gifford:

Plugging and Abandonment Application for Lanipuna No. 6

The Department of Land and Natural Resources (Department) understands that Puna Geothermal Venture is continuing testing of Lanipuna No. 6 with the permission of Barnwell Geothermal Corporation as indicated on the Attachment. In this regard, the Department is returning Water Resources International, Inc.'s $100 filing fee (Check No. 18368 dated May 17, 2001) for the plugging and abandonment permit for geothermal well Lanipuna No. 6. You may resubmit the plugging and abandonment application with filing fee when appropriate.

Should you have any questions, please contact Mr. Harry Yada, Acting Administrator of the Land Division, at 587-0446.

Sincerely,

GILBERT COLOMA-AGARAN

Attachments

WATER RESOURCES INTERNATIONAL, INC.

18368

DEPT. OF LAND & NATURAL RE Ven. No.: 410 Check Date: 5/17/01 Check No: 18368

Your Invoice No.	Date	Amount	Check Total
LANIPUNA #6	5/10/01	$100.00	

01 MAY 21 A10:39

$100.00

[redacted]

WATER RESOURCES INTERNATIONAL, INC.

[redacted]

DATE 5/17/01

AMOUNT $100.00

PAY One Hundred Dollars And 00 Cents

TO THE ORDER OF

DEPT. OF LAND & NATURAL RES.
FISCAL OFFICE
P. O. BOX 621
HONOLULU HI 96809-0621

MP
AUTHORIZED SIGNATURE

[redacted]

SECURITY FEATURES INCLUDED. DETAILS ON BACK.

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

October 17, 2001

Mr. Russell Gifford
Barnwell Geothermal Corporation
1100 Alakea Street, Suite 2900
Honolulu, HI 96813

Subject: **MECHANICAL INTEGRITY TEST, LANIPUNA-6**

Dear Mr. Gifford:

Puna Geothermal Venture (PGV) is requesting approval from Barnwell to perform mechanical integrity testing (MIT) of the Lanipuna-6 well. If this meets with your approval, PGV's intention to make the Integrity Test within the next two weeks, or shortly thereafter. It will require the area to be cleared for wireline unit, crane, kill pump, tanker, and abatement equipment.

Puna Geothermal Venture has contacted Darin Lum, DOH Clean Air Branch, regarding approval to perform the MIT of Lanipuna-6, due to potential H_2S emissions. Please see attachments.

Please return this form with your signature, granting us permission to proceed for our records.

Should you have any questions, please feel free to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

Enclosures

cc: M. Kaleikini/M. Zeibak (PGV)

Approved: Russell Gifford Date 10/18/01

T:/btm/corres.out/misc/011017BGC-LP6.wpd

Water Resources International, Inc.

May 17, 2001

Mr. Gilbert Coloma-Agaran
Chairman
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

RE: Plugging and Abandoning Permit for Lanipuna No. 6

Dear Mr. Coloma-Agaran:

As requested in your letter dated May 10, 2001, copy enclosed, Water Resources International, Inc. hereby transmits a $100.00 non-refundable filing fee for the plugging and abandoning permit for Lanipuna No. 6.

We understand that after the receipt of this fee the Department will process our recent application for abandonment of Lanipuna No. 6.

If you have any questions, please feel free to call me at 531-8422.

Sincerely,

WATER RESOURCES INTERNATIONAL, INC.

Russell M. Gifford
President

RMG/lks

Enclosures

cc: Blaise Clay, Vice President – Drilling Operations
Dean Uchida, Administrator of the Land Division

Honolulu Office: 1100 Alakea Street • Suite 2900 • Honolulu, Hawaii 96813 • Telephone (808) 531-8422 • Fax (808) 531-7181
Big Island Office: P.O. Box 44301 • Kamuela, Hawaii 96743 • Telephone (808) 882-7207 • Fax (808) 882-7655

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT COLOMA-AGARAN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
JANET E. KAWELO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:LD/WL-EK

MAY 10 2001

Mr. Russell M. Gifford, Vice President
Barnwell Geothermal Corporation
1100 Alakea Street, Suite 2900
Honolulu, Hawaii 96813

Dear Mr. Gifford:

Plug and Abandonment Permit for Lanipuna No. 6

The Department of Land and Natural Resources (Department) has received your letter of April 20, 2001, requesting a permit for abandonment of geothermal well Lanipuna No. 6. Pursuant to Section 13-183-81, Hawaii Administrative Rules, application to abandon a well shall be accompanied by a non-refundable filing fee of $100. Upon submittal of the filing fee, the Department will process your application for abandonment of Lanipuna No. 6.

Should you have any questions, please contact Mr. Dean Uchida, Administrator of the Land Division, at 587-0446.

Sincerely,

GILBERT COLOMA-AGARAN

BARNWELL GEOTHERMAL CORPORATION

April 20, 2001

Mr. Gilbert Coloma-Agaran, Chairman
State of Hawaii
Department of Land and Natural Resources
P.O. Box 373
Honolulu, Hawaii 96809

RE:	Well Designation:	Lanipuna No. 6
	Site Designation:	Easement "GW-1" (2 acres)
	Location:	TMK 1-3-8:7, Keahialaka, Puna, Hawaii
	Operator:	Barnwell Geothermal Corporation
	Drilling Contractor:	Water Resources International, Inc.
	Ground Elevation:	600' +/-
	Total Depth:	4,956' G.L.

Dear Mr. Coloma-Agaran:

Barnwell Geothermal Corporation requests a permit to abandon geothermal well Lanipuna No. 6. Attached please find the plugging and abandonment plan.

If you have any questions, please feel free to call me at my office in Honolulu, (808) 531-8400.

Very truly yours,

Russell M. Gifford
Vice President

RMG/lks

cc: Eric Tanaka, DLNR, Hilo, Hawaii
Morton Kinzler, President, Barnwell Geothermal Corporation
Blaise Clay, Vice President, Water Resources International, Inc.

1100 Alakea Street, Suite 2900 · Honolulu, Hawaii 96813 · Telephone (808) 531-8400 · Fax (808) 531-7181

BARNWELL GEOTHERMAL CORPORATION

April 20, 2001

Mr. Gilbert Coloma-Agaran, Chairman
State of Hawaii
Department of Land and Natural Resources
P.O. Box 373
Honolulu, Hawaii 96809

'01 APR 23 AM 09:42 WATER & LAND

RE:	Well Designation:	Lanipuna No. 2
	Site Designation:	Easement "GW-6" (2 acres)
	Location:	TMK 1-3-09:7, Keahialaka, Puna, Hawaii
	Operator:	Barnwell Geothermal Corporation
	Drilling Contractor:	Water Resources International, Inc.

Dear Mr. Coloma-Agaran:

Barnwell Geothermal Corporation requests a permit to abandon the geothermal well cellar at Lanipuna No. 2. No geothermal well was ever drilled at this well site.

If you have any questions, please feel free to call me at my office in Honolulu, (808) 531-8400.

Very truly yours,

Russell M. Gifford
Vice President

RMG/lks

cc: Eric Tanaka, DLNR, Hilo, Hawaii
Morton Kinzler, President, Barnwell Geothermal Corporation
Blaise Clay, Vice President, Water Resources International, Inc.

1100 Alakea Street, Suite 2900 · Honolulu, Hawaii 96813 · Telephone (808) 531-8400 · Fax (808) 531-7181

LANIPUNA NO. 6
PLUGGING & ABANDONMENT PLAN

Well Designation:	Lanipuna No. 6
Site Designation:	Easement "GW-1" (2 acres)
Location:	TMK 1-3-8:7, Keahialaka, Puna, Hawaii
Operator:	Barnwell Geothermal Corporation
Drilling Contractor:	Water Resources International, Inc.
Ground Elevation:	600' +/-
Total Depth:	4,958' G.L.

Also attached are drawings of

1. Current Well Construction "As Built"
2. P & A Proposed "As Built"
3. Map

LANIPUNA NO. 6
PLUGGING & ABANDONMENT PLAN

PLUGGING INTERVALS

A. The open hole below the 7 inch L-80, 32 lb. Hydril threaded casing will be filled with gravel from 4,956 feet to 4,275 feet. This procedure will cover and plug potential lost circulation zones.

B. A 350 lineal foot, high temperature cement plug will be set between 4,275 feet and 3,925 feet, covering the open hole below casing, the bottom of the 7 inch casing liner and the perforations in the 7 inch casing.

C. A 100 lineal foot neat cement plug will then be set between 1,308 feet and 1,208 feet covering the bottom of the 9 5/8 inch K-55, 54.5 lb. buttress threaded casing.

D. A 100 lineal foot neat cement plug will be set between 1,136 feet and 1,036 feet, covering the 7 inch casing liner tie back.

E. A 100 lineal foot neat cement plug will then be set between 618 feet and 518 feet covering static water level.

F. A surface plug extending from –10 feet to a depth of 160 feet will be placed at the top of the hole. A steel cap will then be welded to the top of the casing.

Bentonite slurry will fill the volume between the cement plugs. The attached diagrams illustrate the configuration of the proposed plugging plan.

ABANDONMENT PROCEDURES

1) The site will be prepared and the completion rig and auxiliary equipment mobilized to the site and rigged up.

2) A double ram or annular blow out preventer will be installed on the existing 10 inch 900 master valve and pressure tested

3) Water will be pumped into the well to attempt to fill and cool the hole.

4) A wiper trip to the bottom of the 6 inch bore hole below 7 inch casing depth will be made utilizing tubing or drill pipe with a 6 inch bit.

5) The pipe will be tripped out and the bit removed and tripped back in to the open hole below casing, and gravel will be tremied through the pipe to seal lost circulation zones in the open bore hole.

6) A cement seal will be installed on top of the gravel seal, prior to setting the 350 lineal foot cement plug.

7) After allowing for the cement cap to properly set, the hole will be filled with water.

8) The tubing will be pulled up to 10 feet above the cement/gravel seal, at which time Water Resources International, Inc. will mix and pump through the tubing 50 cubic feet of Hawaiian cement with 40% silica flour and .65% CFR-3 covering 175 lineal feet. The 7 inch casing full of water will create a hydrostatic pressure to pressure squeeze cement around the 7 inch casing shoe joint and open bore below casing.

9) Pull tubing up the hole, flush out cement and wait on cement to set for the required time limit.

10) Tag the plug with the tubing to verify placement. If cement rise is not sufficient, repeat steps 8 and 9 till the proper rise has been achieved to minimum depth of 4,100 feet.

11) Tubing will be set at 10 feet above the cement plug at 4,100 feet +/- and 50 cubic feet of Hawaiian cement with 40% silica flour and .65% CFR-3 will be pumped through tubing to cement the perforations. The hydrostatic pressure of the 7-inch casing full of water will squeeze cement through the perforations.

12) Pull tubing up the hole, flush out cement and wait on cement to set for the required time limit.

13) Tag the plug with the tubing to verify placement. If cement rise is not sufficient, repeat steps 8 and 9 till the proper rise has been achieved to minimum depth of 3,925 feet.

14) Displace the hole with heavy bentonite slurry to 1,308 feet.

15) Twenty (20) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 100 lineal feet from 1,308 feet to 1,208 feet.

16) Pull the tubing up the hole and flush out cement and, after waiting on cement to set for the required time, tag the plug with the tubing to verify placement.

17) Displace the hole with heavy bentonite slurry from 1,208 feet to 1,136 feet.

18) Twenty (20) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 100 lineal feet from 1,136 feet to 1,036 feet.

19) Displace the hole with heavy bentonite slurry to 618 feet.

20) Twenty (20) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 100 lineal feet from 618 feet to 518 feet.

21) Displace the hole with heavy bentonite slurry to 160 feet.

22) Thirty (30) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 150 lineal feet from 160 feet to –10 feet.

An experienced geothermal technical consultant (drilling supervisor or engineer) will be available for down hole operations. If well conditions indicate that changes are required in the abandonment procedure or program, the consultant will be available to discuss and implement any changes with the operator, contractor and DLNR.

FINAL ABANDONMENT

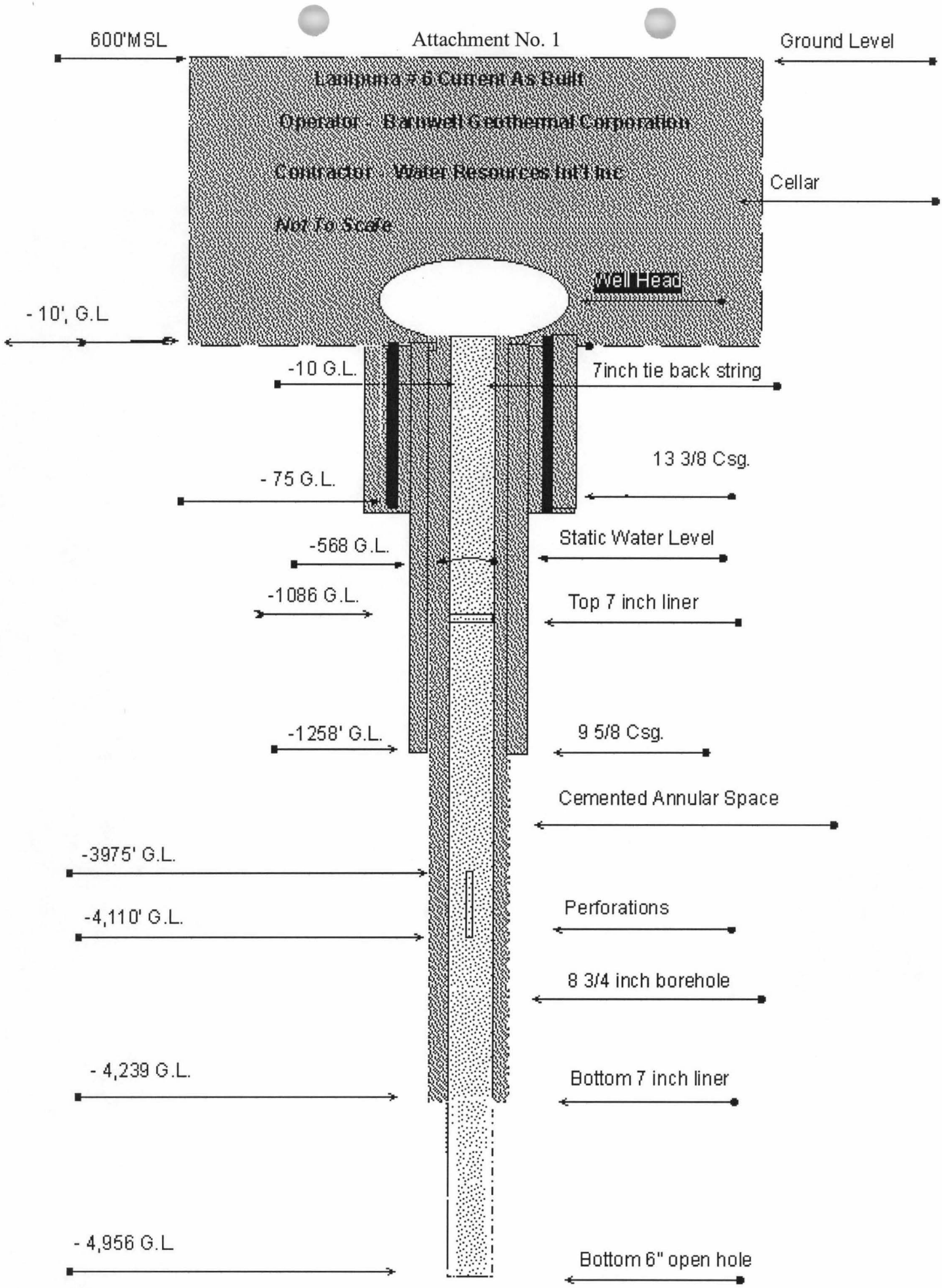
All wellhead valves will be removed and the casing will be cut off near the bottom of the cement cellar with a steel cap welded to the casing. The cellar will be removed and backfilled with crushed lava rock, making it flush with the ground surface.

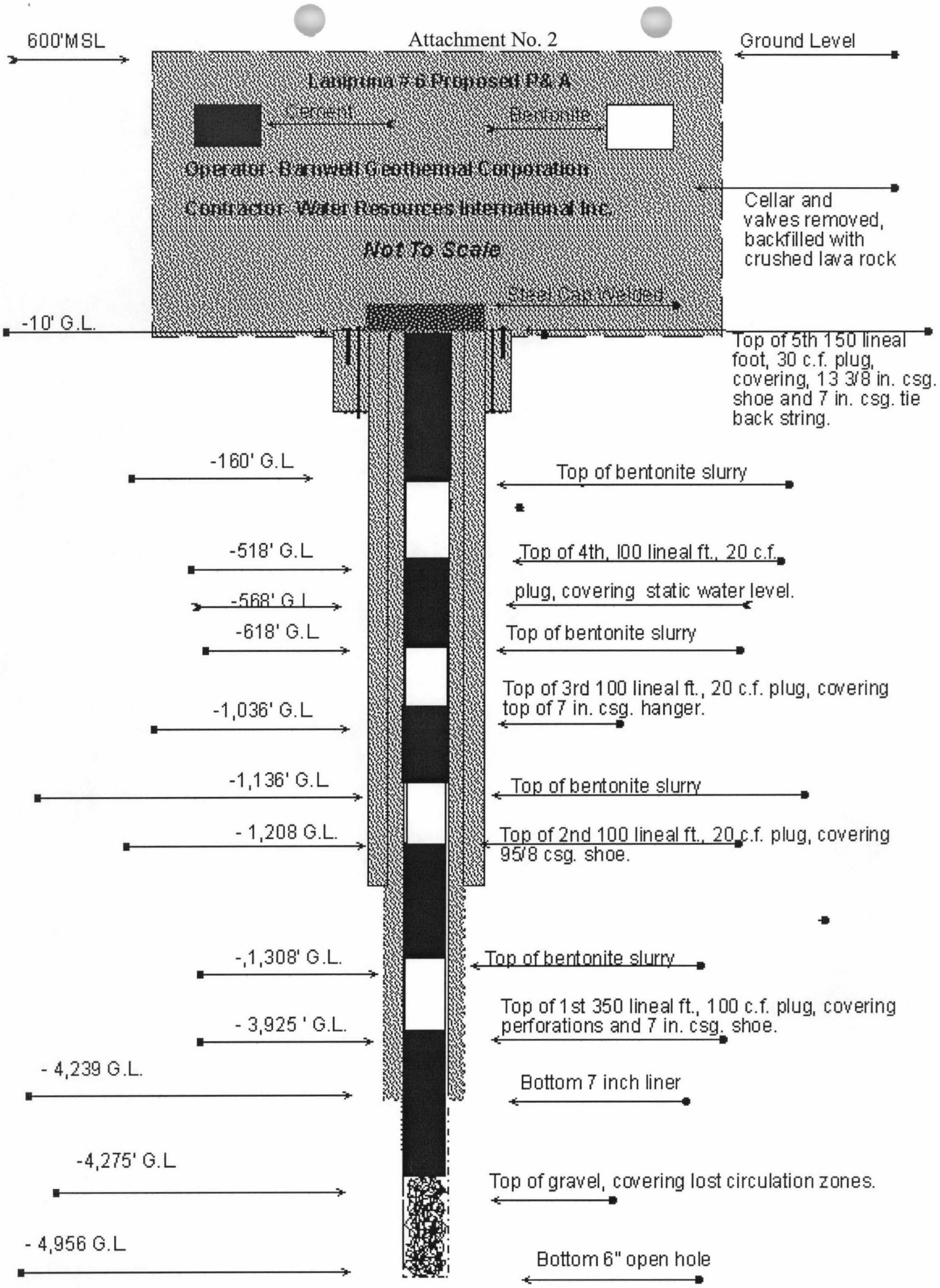
All equipment will be demobilized and the site cleaned.

DOCUMENTATION

Following completion of the plugging and abandonment, all appropriate records of the well will be filed with the Department of Land and Natural Resources.

Attachment No. 1




600'MSL
Attachment No. 2
Ground Level
Laupima #6 Proposed P&A
Cement
Bentonite
Operator: Barnwell Geothermal Corporation
Contractor: Water Resources International Inc.
Not To Scale
Cellar and valves removed, backfilled with crushed lava rock
Steel Cap Welded
-10' G.L.
Top of 5th 150 lineal foot, 30 c.f. plug, covering, 13 3/8 in. csg. shoe and 7 in. csg. tie back string.
-160' G.L
Top of bentonite slurry
-518' G.L
Top of 4th, 100 lineal ft., 20 c.f.
-568' G.L
plug, covering static water level.
-618' G.L
Top of bentonite slurry
Top of 3rd 100 lineal ft., 20 c.f. plug, covering top of 7 in. csg. hanger.
-1,036' G.L
-1,136' G.L
Top of bentonite slurry
- 1,208 G.L.
Top of 2nd 100 lineal ft., 20 c.f. plug, covering 95/8 csg. shoe.
-,1,308' G.L.
Top of bentonite slurry
Top of 1st 350 lineal ft., 100 c.f. plug, covering perforations and 7 in. csg. shoe.
- 3,925 ' G.L.
- 4,239 G.L.
Bottom 7 inch liner
-4,275' G.L
Top of gravel, covering lost circulation zones.
- 4,956 G.L
Bottom 6" open hole

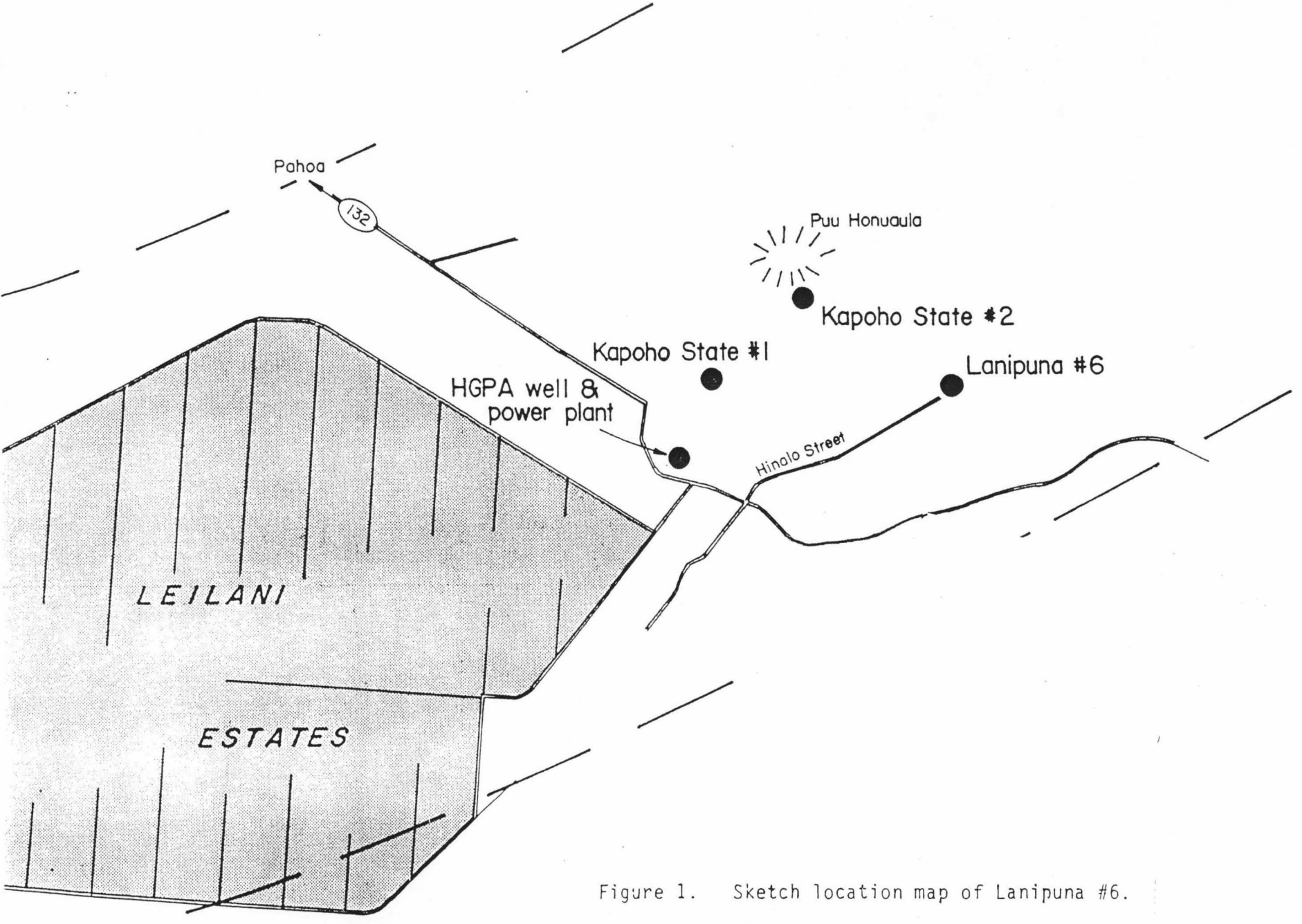


Figure 1. Sketch location map of Lanipuna #6.

Attachment No. 3

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
JANET E. KAWELO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS
WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

FACSIMILE TRANSMITTAL PAGE

Please deliver the following pages to:

Name: Alyson Yim

Company: Engineering Branch, Honolulu

From: Eric Tanaka

Date: 3-15-01

Massages: Attached are the drafts of the P & A Plans and application letters from Barnwell Corporation for Lanipuna No. 6 and Lanipuna N0. 2 well cellar demolition.

I will be e-mailing you the draft of the P & A Permit for Lanipuna No. 6.

Lanipuna No. 2 well cellar did not have any permit issued and don't think there is a need for a permit, just the removal of the cellar from the property.

If there are any questions to any of the above, please feel free to call me.

Total no. Of pages (including transmittal pages): 9_
The original document will not be sent in the mail
if you do not receive all the pages legibly, please call (808) 974-6210
Sending Fax No.: 974-6222
Receiving Fax No.:

BARNWELL GEOTHERMAL CORPORATION

February xx, 2001

DRAFT

Mr. Gilbert Coloma-Agaran, Chairman
State of Hawaii
Department of Land and Natural Resources
P.O. Box 373
Honolulu, Hawaii 96809

RE:	Well Designation:	Lanipuna No. 2
	Site Designation:	Easement "GW-6" (2 acres)
	Location:	TMK 1-3-09:7, Keahialaka, Puna, Hawaii
	Operator:	Barnwell Geothermal Corporation
	Drilling Contractor:	Water Resources International, Inc.

Dear Mr. Coloma-Agaran:

Barnwell Geothermal Corporation requests a permit to abandon the geothermal well cellar at Lanipuna No. 2. No geothermal well was ever drilled.

If you have any questions, please feel free to call me at my office in Honolulu, (808) 531-8400.

Very truly yours,

Russell M. Gifford
Vice President

RMG/lks

cc: Erik Tanaka, DLNR, Hilo, Hawaii
Blaise Clay, Vice President, Water Resources International, Inc.

BARNWELL GEOTHERMAL CORPORATION

DRAFT

February xx, 2001

Mr. Gilbert Coloma-Agaran, Chairman
State of Hawaii
Department of Land and Natural Resources
P.O. Box 373
Honolulu, Hawaii 96809

RE:	Well Designation:	Lanipuna No. 6
	Site Designation:	Easement "GW-1" (2 acres)
	Location:	TMK 1-3-8:7, Keahialaka, Puna, Hawaii
	Operator:	Barnwell Geothermal Corporation
	Drilling Contractor:	Water Resources International, Inc.
	Ground Elevation:	600' +/-
	Total Depth:	4,956' G.L.

Dear Mr. Coloma-Agaran:

Barnwell Geothermal Corporation requests a permit to abandon geothermal well Lanipuna No. 6. Attached please find the plugging and abandonment plan.

If you have any questions, please feel free to call me at my office in Honolulu, (808) 531-8400.

Very truly yours,

Russell M. Gifford
Vice President

RMG/lks

cc: Erik Tanaka, DLNR, Hilo, Hawaii
Blaise Clay, Vice President, Water Resources International, Inc.

1100 Alakea Street, Suite 2900 · Honolulu, Hawaii 96813 · Telephone (808) 531-8400 · Fax (808) 531-7181

1100 Alakea Street, Suite 2900 · Honolulu, Hawaii 96813 · Telephone (808) 531-8400 · Fax (808) 531-7181

DRAFT

LANIPUNA NO. 6
PLUGGING & ABANDONMENT PLAN
November 27, 2000

PLUGGING INTERVALS

A. The open hole below the 7 inch L-80, 32 lb. Hydril threaded casing will be filled with gravel from 4,956 feet to 4,275 feet. This procedure will cover and plug potential lost circulation zones.

B. A 350 lineal foot, high temperature cement plug will be set between 4,275 feet and 3,925 feet, covering the open hole below casing, the bottom of the 7 inch casing liner and the perforations in the 7 inch casing.

C. A 100 lineal foot neat cement plug will then be set between 1,308 feet and 1,208 feet covering the bottom of the 9 5/8 inch K-55, 54.5 lb. buttress threaded casing.

D. A 100 lineal foot neat cement plug will be set between 1,136 feet and 1,036 feet, covering the 7 inch casing liner tie back.

E. A 100 lineal foot neat cement plug will then be set between 618 feet and 518 feet covering static water level.

F. A surface plug extending from ~10 feet to a depth of 160 feet will be placed at the top of the hole. A steel cap will then be welded to the top of the casing.

Bentonite slurry will fill the volume between the cement plugs. The attached diagrams illustrate the configuration of the proposed plugging plan.

ABANDONMENT PROCEDURES

1) The site will be prepared and the completion rig and auxiliary equipment mobilized to the site and rigged up.

2) A double ram or annular blow out preventer will be installed on the existing 10 inch 900 master valve and pressure tested

3) Water will be pumped into the well to attempt to fill and cool the hole.

4) A wiper trip to the bottom of the 6 inch bore hole below 7 inch casing depth will be made utilizing tubing or drill pipe with a 6 inch bit.

5) The pipe will be tripped out and the bit removed and tripped back in to the open hole below casing, and gravel will be tremied through the pipe to seal lost circulation zones in the open bore hole.

6) A cement seal will be installed on top of the gravel seal, prior to setting the 350 lineal foot cement plug.

7) After allowing for the cement cap to properly set, the hole will be filled with water.

8) The tubing will be pulled up to 10 feet above the cement/gravel seal, at which time Water Resources International, Inc. will mix and pump through the tubing 50 cubic feet of Hawaiian cement with 40% silica flour and .65% CFR-3 covering 175 lineal feet. The 7 inch casing full of water will create a hydrostatic pressure to pressure squeeze cement around the 7 inch casing shoe joint and open bore below casing.

9) Pull tubing up the hole, flush out cement and wait on cement to set for the required time limit.

10) Tag the plug with the tubing to verify placement. If cement rise is not sufficient, repeat steps 8 and 9 till the proper rise has been achieved to minimum depth of 4,100 feet.

11) Tubing will be set at 10 feet above the cement plug at 4,100 feet +/- and 50 cubic feet of Hawaiian cement with 40% silica flour and .65% CFR-3 will be pumped through tubing to cement the perforations. The hydrostatic pressure of the 7 inch casing full of water will squeeze cement through the perforations.

12) Pull tubing up the hole, flush out cement and wait on cement to set for the required time limit.

13) Tag the plug with the tubing to verify placement. If cement rise is not sufficient, repeat steps 8 and 9 till the proper rise has been achieved to minimum depth of 3,925 feet.

14) Displace the hole with heavy bentonite slurry to 1,308 feet.

15) Twenty (20) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 100 lineal feet from 1,308 feet to 1,208 feet.

16) Pull the tubing up the hole and flush out cement and, after waiting on cement to set for the required time, tag the plug with the tubing to verify placement.

17) Displace the hole with heavy bentonite slurry from 1,208 feet to 1,136 feet.

18) Twenty (20) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 100 lineal feet from 1,136 feet to 1,036 feet.

19) Displace the hole with heavy bentonite slurry to 618 feet.

20) Twenty (20) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 100 lineal feet from 618 feet to 518 feet.

21) Displace the hole with heavy bentonite slurry to 160 feet.

22) Thirty (30) cubic feet of Hawaiian cement will be mixed and pumped through the tubing to cover 150 lineal feet from 160 feet to –10 feet.

An experienced geothermal technical consultant (drilling supervisor or engineer) will be available for down hole operations. If well conditions indicate that changes are required in the abandonment procedure or program, the consultant will be available to discuss and implement any changes with the operator, contractor and DLNR.

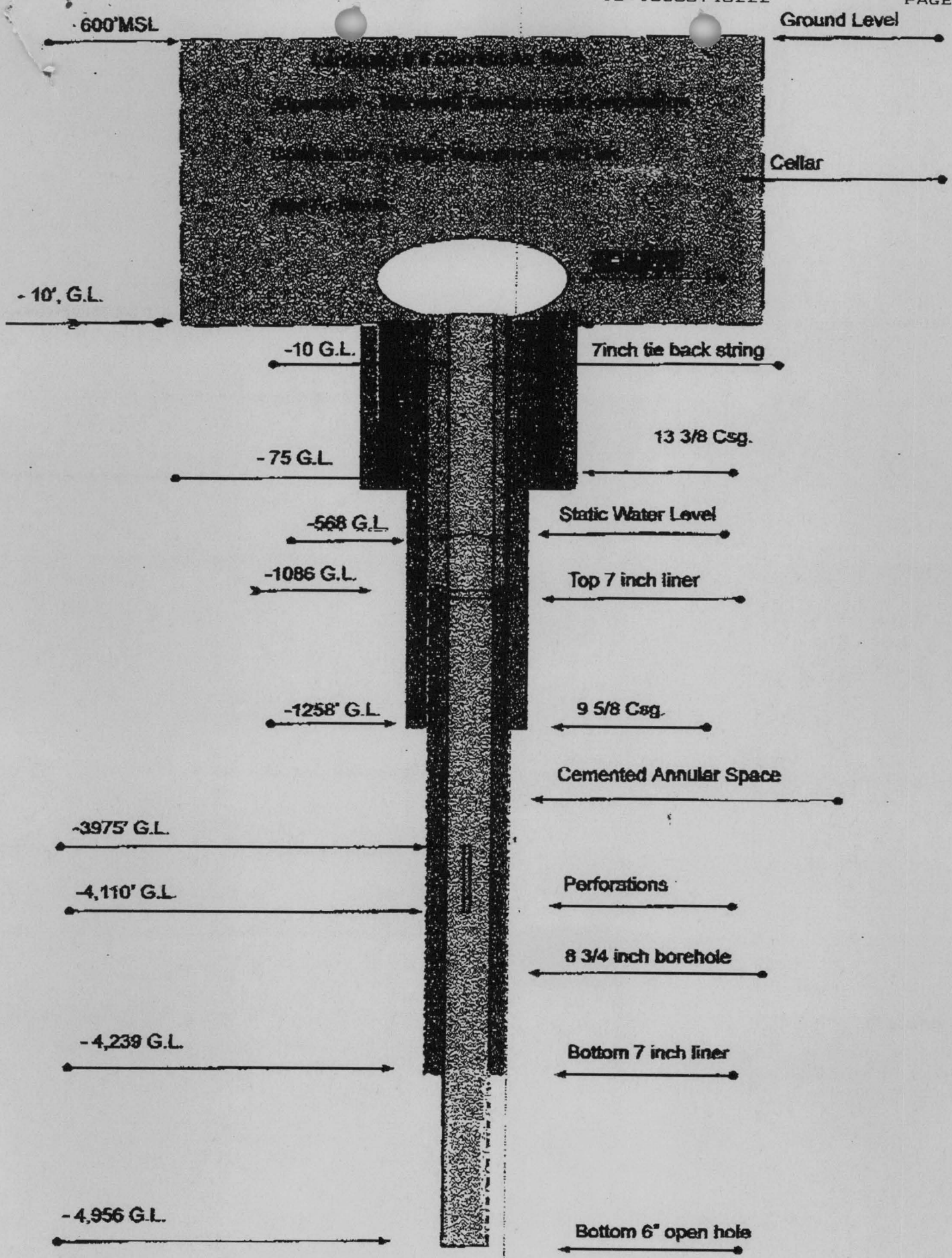
FINAL ABANDONMENT

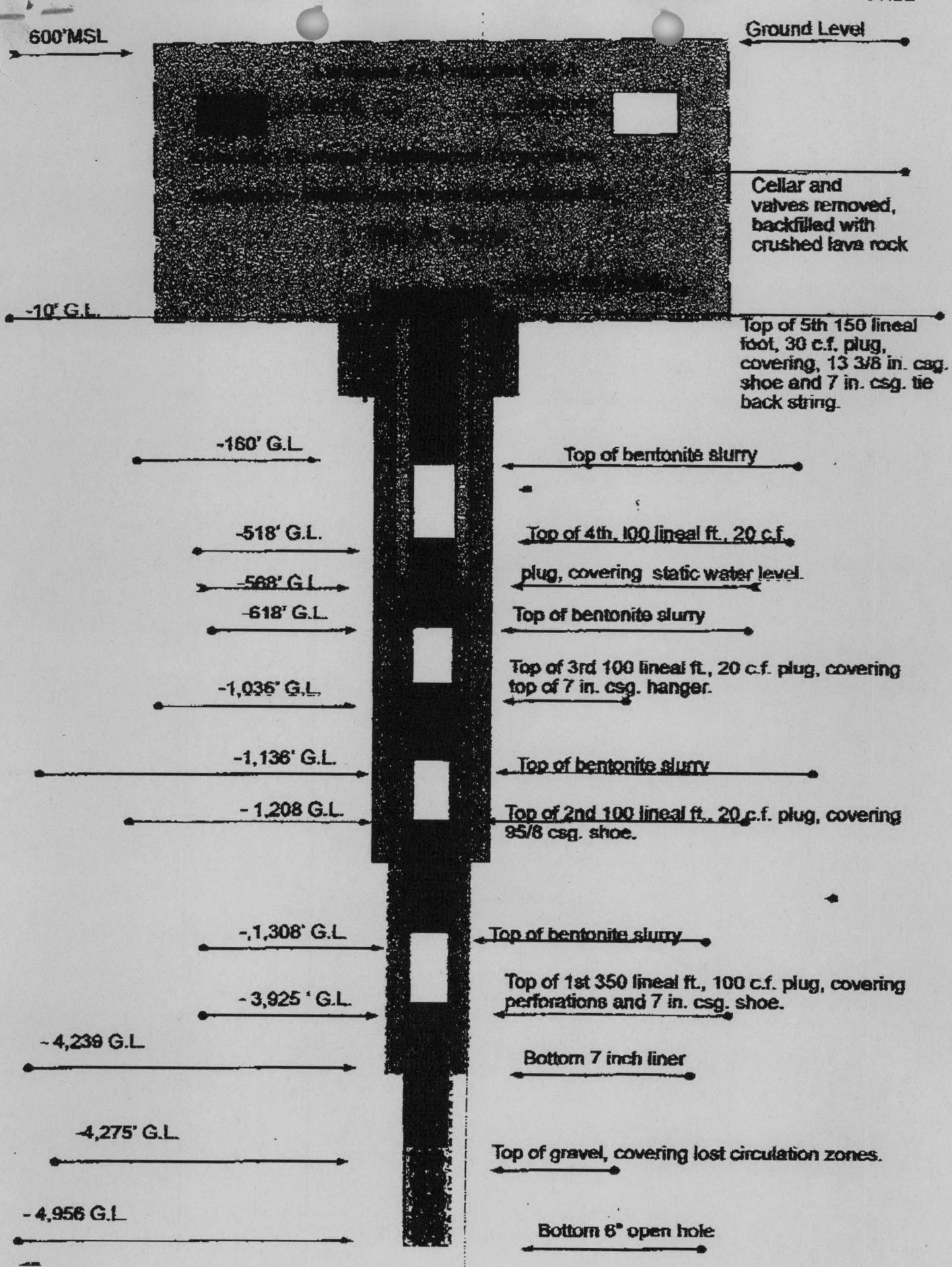
All wellhead valves will be removed and the casing will be cut off near the bottom of the cement cellar with a steel cap welded to the casing. The cellar will be removed and backfilled with crushed lava rock, making it flush with the ground surface.

All equipment will be demobilized and the site cleaned.

DOCUMENTATION

Following completion of the plugging and abandonment, all appropriate records of the well will be filed with the Department of Land and Natural Resources.


600'MSL
Ground Level
Cellar
- 10', G.L.
-10 G.L.
7inch tie back string
13 3/8 Csg.
- 75 G.L.
-568 G.L.
Static Water Level
-1086 G.L.
Top 7 inch liner
-1258' G.L.
9 5/8 Csg.
Cemented Annular Space
-3975' G.L.
-4,110' G.L.
Perforations
8 3/4 inch borehole
- 4,239 G.L.
Bottom 7 inch liner
- 4,956 G.L.
Bottom 6" open hole


600'MSL
Ground Level
Cellar and valves removed, backfilled with crushed lava rock
-10' G.L.
Top of 5th 150 lineal foot, 30 c.f. plug, covering, 13 3/8 in. csg. shoe and 7 in. csg. tie back string.
-160' G.L.
Top of bentonite slurry
-518' G.L.
Top of 4th. 100 lineal ft., 20 c.f.
-568' G.L.
plug, covering static water level.
-618' G.L.
Top of bentonite slurry
Top of 3rd 100 lineal ft., 20 c.f. plug, covering top of 7 in. csg. hanger.
-1,036' G.L.
-1,136' G.L.
Top of bentonite slurry
- 1,208 G.L.
Top of 2nd 100 lineal ft., 20 c.f. plug, covering 95/8 csg. shoe.
-,1,308' G.L.
Top of bentonite slurry
Top of 1st 350 lineal ft., 100 c.f. plug, covering perforations and 7 in. csg. shoe.
- 3,925 ' G.L.
- 4,239 G.L.
Bottom 7 inch liner
-4,275' G.L.
Top of gravel, covering lost circulation zones.
- 4,956 G.L.
Bottom 6" open hole

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
EMD / SDWB

November 30, 2001

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Andrew Monden, Chief Engineer
Land Division, Engineering Branch
Department of Land & Natural Resources
P.O. Box 373
Honolulu, Hawaii 96809

'01 DEC 06 AM 09:11 WATER & LAND

Dear Mr. Monden:

SUBJECT: PUNA GEOTHERMAL VENTURE
UNDERGROUND INJECTION CONTROL (UIC)
PROPOSED STATE UIC PERMIT RENEWAL
UIC PERMIT NO. UH-1529, AND
PROPOSED CONSTRUCTION OF NEW INJECTION WELLS

The Department of Health (DOH) thanks you for your interest and participation regarding Puna Geothermal Venture's UIC permit renewal and new injection well construction applications.

This provides notice that on October 24, 2001, the DOH approved Puna Geothermal Venture's applications for 1) the above-referenced permit renewal to operate three injection wells and 2) the construction of up to seven new injection wells. Enclosed are copies of the UIC permit and the letter of approval-to-construct (ATC) for the proposed injection wells. Please note that the approval-to-construct letter is not an authorization to use a newly constructed injection well. Use of a newly constructed injection well can only occur after injection test results and other related data are satisfactorily received and evaluated by the DOH.

As you may be aware, the Federal UIC permit to operate the existing three injection wells and to construct up to seven new injection wells was issued to the facility on August 25, 2000. The conditions of the enclosed State UIC permit closely parallel many of the conditions of the Federal UIC permit. For example, monitoring and reporting parameters, pressure requirements, scheduling of events, and the duration of the permits are some of the identical elements of both the State and Federal UIC permits

However, there are certain conditions that are contained in the Federal UIC permit that are not contained in the State UIC permit because those conditions are not covered by the State UIC regulations, but they are addressed by another State agency's regulations. For example, financial responsibility requirements to properly abandon an injection well are defined in the Federal UIC permit, whereas the State's financial responsibility requirement would be addressed by the Department of Land and Natural Resources.

Our records indicate that you participated in the public hearing that was conducted on April 3, 1998. If you desire, you may petition the DOH for a contested case hearing in accordance with the DOH Rules of Practice and Procedure, Part C.2(c). The purpose of a contested case hearing is to challenge the decisions made by the DOH. The petition to the DOH must be received within thirty (30) days from your receipt of this notice. Mail your response by certified mail to:

Safe Drinking Water Branch
State Department of Health
Attn: Chauncey Hew
919 Ala Moana Blvd., Room 308
Honolulu, Hawai`i 96814-4920
Telephone: (808) 586-4258
Fax: (808) 586-4370

Thank you for your interest and participation in this important process.

If you have any questions about this subject, please call Chauncey Hew of the Safe Drinking Water Branch at 586-4258 (Honolulu) or call direct toll free from Big Island at 974-4000, ext. 64258.

Sincerely,

WILLIAM WONG, P.E., CHIEF
Safe Drinking Water Branch
Environmental Management Division

CH:chl

Enclosures: 1. UIC Permit No. UH-1529
2. ATC Letter

c: Lee-Ann Brewer, Deputy Attorney General

FILE COPY

October 24, 2001 10002UCH.01

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778

Dear Mr. Mizuno:

SUBJECT: PUNA GEOTHERMAL VENTURE (PGV)
UNDERGROUND INJECTION CONTROL (UIC)
UIC PERMIT APPLICATION FOR NEW INJECTION WELLS
UIC PERMIT APPLICATION NO. UH-1529A

We have completed the review of your preliminary application for new injection well construction and have determined that the conditions for the granting-of-approval to construct up to seven (7) injection wells at the subject facility have been satisfied. Therefore, you are hereby granted approval to construct the seven injection wells.

This approval to construct is based on the plans and information that were provided in the PGV preliminary application dated August 13, 1997, the public hearing held on April 3, 1998 at Pahoa High School, and the U.S. Environmental Protection Agency's UIC Individual Permit, Class V Injection, Permit No. HI596002 issued on August 25, 2000 to PGV. Any modifications to the proposed injection wells, their operation or manner in which injection is to occur, subsequent to this approval, shall require our approval before implementation. Any modifications conducted without our approval will constitute a violation of Chapter 11-23.

This approval to construct is valid for a time period of 180 calendar days from the date of this letter. You are required to notify us verbally and in writing at least 7 days before starting construction activities. Unless construction is started within the 180-day time period, this approval to construct will be void. If construction is expected to occur after the 180-day time period, you are required to ask in writing for a time extension at least 30 days before the expiration of this approval. Copies of this approval and the preliminary application shall be kept at the construction site, where practicable.

This approval to construct does not constitute a permit to operate the injection facility upon completion of construction. Depending on the data obtained during construction, a permit to operate may or may not be issued.

Pursuant to Section 11-23-13, as amended, please submit your final application documents consisting of a certified engineering report prepared by a geologist and professional engineer in accordance with the enclosed "Final Report Format For New or Modified Injection Well." This submittal should be made as soon as possible following the construction and testing of the injection wells to expedite the final processing of your UIC permit application.

You are required to notify Chauncey Hew of the Safe Drinking Water Branch two weeks prior to the injection well testing. You will be informed if departmental personnel will be present to witness the injection well testing. If you conduct the injection well test without notifying the department, you will be required to redo the injection well test under proper witnessing.

If you have any questions about the final application document, or the processing of your application, please call Chauncey Hew of the Safe Drinking Water Branch at 586-4258 or call direct toll free from Big Island at 974-4000, ext. 64258.

Sincerely,

GARY GILL, DEPUTY DIRECTOR
Environmental Health Administration

CH:chl

Enclosure: Final Report Format for New or Modified Injection Well

c:
1. Glenn Tomori, Sanitarian, East Hawaii (w/encl.)
2. Mr. Christopher Yuen, Director, Planning Department, Hawaii County (w/encl.)
3. Mr. Gil S. Coloma-Agaran, Chairman, DLNR (w/encl.)
4. Dr. Seiji Naya, Director, DBEDT (w/encl.)
5. Ms. Laura Tom Bose, Chief
   Ground Water Office
   USEPA, Region 9 (w/encl.)

UICCORR(PGVNEW.HCH)

FINAL REPORT FORMAT FOR NEW OR MODIFIED INJECTION WELL UNDERGROUND INJECTION CONTROL (UIC)

UIC APPLICATION NO. UH-1529A UIC PERMIT NO. UH-1529

1. General Information:
   a) Facility name;
   b) Name and address of Operator and Owner.

2. Physical Characteristics of the Area:
   a) Location and accessibility;
   b) Climate;
   c) Topography;
   d) Geologic and foundation conditions;
   e) Earthquake considerations;
   f) Flood potential including tsunami inundation zones;
   g) Conformance with local land-use planning and zoning regulations;
   h) Sensitive environments: natural or community-related.

3. Injection Well System:
   a) Actual number of injection wells constructed or modified;
   b) Date of construction or modification;
   c) Security from unauthorized access;
   d) Site plan (drawn to scale) showing location of constructed or modified injection well(s);
   c) Description of any changes from the permit application.

4. Hydrogeologic Characteristics:
   a) Well log (geologic profile) by geologist:
      (1) Lithology of injection intervals and confining formations that incorporate descriptive terminologies for soil and rock;
      (2) Physical and structural characteristics of the formations encountered. The following characteristics shall be used in the descriptions: color, hardness (competency), degree of weathering, qualitative degree of fracturing or consolidation, qualitative degree of vesiculation or porosity, unified soil classification for soils, volcanic series or lithologic formation for rock, petrologic terminologies for rock and cinder, lava type, and the differentiation between soil and rock units;

b) Injection testing:

(1) Minimum 12 hours of continuous injection testing for all wells. Furthermore, the duration of injection testing should accommodate all test objectives satisfactorily in order to insure safe and proper long-term injection well operations.

(2) Complete results of injection testing including maximum injection capacity of the well and hydraulic conductivity of the injection formation;

c) Groundwater characteristics:

(1) Initial water level, and subsequent water level as fluctuations occur;

(2) Tidal fluctuations and tidal efficiency;

(3) Continuous total dissolved solids and/or salinity profile for all wells, representatively taken before the introduction of any foreign fluids. The profiles shall represent stabilized conditions without influence or restriction from any well casing for new well construction and shall extend to the bottom of the boring. Profiles within solid casing strings are not acceptable for new injection well construction;

(4) Water samples and analytical results from the following levels: at the water table, at the top of injection interval, at the bottom of boring, midway between water table and top of injection interval, and midway between top of injection internal and bottom of boring or;

Water samples and analytical results from each distinct zone of significantly different total dissolved solids or salinity concentration levels.

Water samples shall be analyzed using EPA or EPA equivalent standards and methods for the following parameters:

Parameter	EPA Method
chlorides	325
conductivity (specific conductance)	120
dissolved oxygen	360
field pH	150
field temperature	170
Total Dissolved Solids	160

5. Special considerations to be addressed by this report: For item No. 4, water sampling will be affected by whether the injection well is being newly constructed or converted from a well of prior use. Depending on the circumstance, water sample collection and testing criteria shall be confirmed by the Department before implementation in order to establish relevant objectives and results.

6. Attach an original Signatory and Certification Statement sheet signed and dated by the operator or legal representative of the facility.

7. Preparers' signature: The final report shall be signed by the geologist and licensed engineer and shall bear the engineer's stamp.

STATE OF HAWAII

DEPARTMENT OF HEALTH

UNDERGROUND INJECTION CONTROL (UIC)

PERMIT NO. UH-1529

FACILITY IDENTIFICATION NO. 8-2883.01

for

PUNA GEOTHERMAL VENTURE

Operated By
COSI Puna, Inc.

TABLE OF CONTENTS

Appendices

AUTHORIZATION TO OPERATE UNDER THE UNDERGROUND INJECTION CONTROL PROGRAM

In compliance with the provisions of the Safe Drinking Water Act, Chapter 340E, Hawaii Revised Statutes (HRS), as amended, and Hawaii Administrative Rules (HAR), Title 11, Chapter 23, Underground Injection Control, as amended;

PUNA GEOTHERMAL VENTURE
Operated by
COSI Puna, Inc.

is authorized to operate a Class V, Subclass E, injection well system consisting of three (3) injection wells known as geothermal wells Kapoho State 1A (KS-1A), Kapoho State 3 (KS-3), and Kapoho State 4 (KS-4):

Injection Well No.	Located on Well Pad	Approx. Well Head Elevation Above Mean Sea Level
KS-1A	A	617 Feet
KS-3	E	618 Feet
KS-4	E	618 Feet

and having the specifications as listed in Figure No. 1, Figure No. 2, and Figure No. 3, respectively; to inject the geothermal fluids consisting of geothermal brine, geothermal steam condensate, and geothermal noncondensible gases which are produced during the operation of the well field and power plant; and the intermittent inclusion of injection supplement water; back into the geothermal reservoir at an interval between the approximate depths of 3,900 feet and 7,300 feet, in reference to the Kelly Bushing;

located at the facility's address of 14-3860 Kapoho Pahoa Road, Pahoa, Hawaii 96778 at Tax Key Number, 3rd Div. 1-4-01:2 and 19; at the approximate well pad coordinates:

Well Pad A: Latitude 19° 28' 49" N and Longitude 154° 53' 35" W;
Well Pad E: Latitude 19° 28' 41" N and Longitude 154° 53' 40" W;

under Facility Identification Number: 8-2883.01.1-3;

in accordance with monitoring conditions, and other terms and conditions set forth in Parts I, II, and III hereof.

This permit becomes effective upon issuance.

This permit and the authorization to operate the three (3) injection wells will expire at midnight, August 24, 2005.

Issued on the 20th day of October 2001.

(For) Director of Health

A. OPERATING CONDITIONS:

1. Injectant Characteristics

Injectant in this permit is limited to geothermal fluids consisting of geothermal brine, geothermal steam condensate, geothermal noncondensible gases, chemical additives for well casing corrosion, scale and biofouling control, tracers, and injection supplemental water, that may include the chemical parameters listed in **Table No. 1**.

2. Injection Limitations and Prohibitions

(a) Injectant in this permit is exclusively limited to the injectant described in Part I A.1. above; furthermore, any injectant not described in Part I A.1. is explicitly prohibited unless the injectant characteristics of this permit are revised accordingly.

(b) No discharge of hazardous wastes as defined by Title 40, Code of Federal Regulations (CFR), Part 261.

(c) Injection Pressure:

The maximum injection pressure as measured at the well head shall not exceed 500 psi gauge or the fracture pressure of the receiving formation, whichever is less.

(d) Annular Pressure:

Annular nitrogen pressure for all injection wells shall be constantly maintained to depress the nitrogen/water interface to a depth of at least 2000 feet, relative to the kelly bushing, approximately 1975 feet below ground surface.

(e) Concentrations of the Injectant

Chemical and physical analyses are required as detailed in Part I B. 1. (c) of this permit to determine the chemical concentration levels and/or the physical nature of the injectant. Chemical analyses in Part I B. 1. (c) may include analyses that are capable of analyzing the injectant for the characteristics of a hazardous waste, for volatile organic compounds, or for dissolved nutrients associated with the processes of eutrophication.

Certain chemical and/or physical parameters may be specified in this permit with an Action Level, a Regulatory Level, or both. Regulatory Levels shall not be exceeded. Chemical and/or physical parameters with or without specified Action Levels or Regulatory Levels may be subject to revised concentration levels pursuant to changing concerns related to public or environmental health, safety, or relevant laws and regulations.

B. MONITORING AND REPORTING CONDITIONS:

1. Injectant and Injection Well Monitoring

(a) Injectant samples, measurements, and analyses taken or conducted as required by this permit shall be valid and representative of the volume and nature of the injectant. Pursuant to the monitoring and reporting conditions of this permit, detailed records of the operation of the injection wells shall be kept by the permittee. When applicable, records shall include at a minimum the following information:

(1) Type of injectant.
(2) Quantity of injectant.
(3) The method of injection.
(4) Injection pressure.
(5) The rate of injection.
(6) The operational status of the injection well.
(7) The exact date and time of the measurement or sampling.
(8) The person(s) who performed the measurement or sampling.
(9) The dates the analyses were performed.
(10) The person(s) who performed the analyses.
(11) The analytical techniques or methods used.
(12) The results of all required analyses and permit limits.
(13) Chain of Custody.

(b) A daily record of the injectant quantity (gpd) being discharged into each injection well shall be kept. Injectant quantity recordings shall be continuously made through a direct measurement of the wastestream or by a method approved by the Director. A **monthly** summary giving the daily amounts of injectant for each well shall be submitted to the Department.

A continuous recording of the injection pressure (psig) and annular pressure at the well head shall be kept. Pressure recordings shall be documented on a graphical chart, such as a strip chart or circular chart, or log that shows the relationship between pressure and elapse time. A **monthly** summary giving the daily injection and annular pressures for each well shall be submitted to the Department. The annular pressures shall be compared against the calculated required pressure to maintain the proper depth of the nitrogen/water interface.

A daily record of the injectant temperature being discharged into each injection well shall be maintained. Injectant temperature recordings shall be continuously monitored and recorded. A **monthly** summary giving the daily average injection temperature for each well shall be submitted to the Department.

The use of injection supplemental water discharged into the injection wells shall be recorded. The recording shall be directly and continuously made to measure the flow of supplemental water. A **monthly** summary giving the daily amounts of supplemental water used shall be submitted to the Department.

Chemical additions being used for corrosion, scale, and biofouling control shall be recorded. The record shall account for the daily, weekly, and monthly consumptive amounts of each chemical. A **monthly** summary giving the monthly consumptive amount of each chemical shall be submitted to the Department.

(c) Representative grab samples (three types: Types I, III, and IV) of the injectant shall be collected from a collection point to be established by the permittee and approved by the Director. The permittee shall collect and analyze the samples and report the analytical results according to the conditions and the Monitoring and Reporting Schedule of this permit. The collection and analysis of the samples shall be conducted by a laboratory acceptable to the Director. If the laboratory is unable to perform the sample collection, the Director may allow the permittee to collect the sample under the direction of the laboratory.

All samples shall be collected, transported, preserved, stored, documented, analyzed, and reported in accordance with EPA or EPA equivalent methods or standards, and all such activities shall be performed properly and satisfactorily in order to produce valid samples and analytical results. The falsification, fabrication, tampering, or improper handling and management of the samples, chain-of-custody form, or analytical results shall be a violation of this permit.

Methods of analysis shall be as stated herein or approved by the Director. The frequency of sample collection and the type of analyses are as described:

Type I Sample:

(1) Type I samples shall be collected and analyzed at least once every two months. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.

(2) Type I samples shall be analyzed for the test parameters listed in **Table No. 2**.

(3) Type I samples shall be collected between the hours of 9 a.m. and 3 p.m.

(4) The analytical results from this phase of analysis (Type I) shall be submitted to the Department and a copy shall be kept on file at the facility.

Type III Sample:

(1) Type III samples shall be collected and analyzed at least once every six months in conjunction with Type I samples. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.

(2) Type III samples shall be analyzed for Ignitability, Corrosivity, Reactivity, and Method 1311: Toxicity Characteristic Leaching Procedure (TCLP) as described in 40 CFR, Part 261, Appendix II. Reference is hereby made to **Table No. 3** which lists the test parameters for which the analysis shall be conducted under Method 1311. Regulatory levels of the chemical parameters are listed for reference.

(3) Type III samples shall be collected between the hours of 9 a.m. and 3 p.m.

(4) The analytical results from this phase of analysis (Type III) shall be submitted to the Department and a copy shall be kept on file at the facility.

Type IV Sample:

(1) Type IV samples shall be collected and analyzed at least once every six months in conjunction with Type I and III samples. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.

(2) Type IV samples shall be analyzed for volatile organic compounds as described in 40 CFR, Part 136, Appendix A, Method 624. Reference is hereby made to **Table No. 4** which lists the test parameters and the analytical methods.

(3) Type IV samples shall be collected between the hours of 9 a.m. and 3 p.m.

(4) The analytical results from this phase of analysis (Type IV) shall be submitted to the Department and a copy shall be kept on file at the facility.

(d) The collection of Type III and Type IV samples shall be witnessed by departmental personnel unless a waiver to this condition is granted by the Director. The permittee shall notify the Department at least seven (7) days prior to the date of sample collection for this phase of analysis. Any Type III and Type IV samples that are collected without the acknowledgement and inspection by departmental personnel, unless waived by the Director, will not serve to comply with the monitoring and reporting conditions of this permit.

(e) Every exceeding of an Action Level or Regulatory Level concentration shall prompt an immediate (within five (5) days from the time of knowledge of the initial analytical results) resampling for and reanalysis of the particular exceeding test parameter. If a Risk-Based Corrective Action or an Oily Wastewater-related action level is exceeded, the reanalysis shall be conducted by using the same method. If a TCLP-related action level is exceeded, the reanalysis shall be conducted by using Method 1311: TCLP as described in 40 CFR, Part 261, Appendix II. If a TCLP regulatory level is exceeded, the reanalysis shall be conducted by using the same method.

The permittee shall immediately notify the Department of every exceeding of an Action Level or Regulatory Level concentration and shall submit the original and follow-up analytical results. The Department may impose additional conditions on resampling and reanalysis.

(f) A periodic recorded inspection of the injection well system at least once every week shall be conducted by the permittee. The inspection shall include the recordation of the operational status of the injection well system to detect any deterioration of the injection well system and associated operations that might lead to an injection well failure, and provide the opportunity to correct any occurrence of prohibited discharge activity. The person conducting the periodic inspection shall be knowledgeable of what is unlawful disposal of chemical compounds, petroleum products and other hazardous substances into the injection well. If such activities are encountered, the permittee shall take immediate action to alleviate, correct, clean up, and record such disposal incidents. The recorded inspection including any disposal incidents shall be kept at the facility and be made available for inspection by departmental personnel.

(g) A periodic status report shall be completed at least **once every 3 months** regarding the condition and performance of the injection well system. The status report shall be made by a professional consultant, engineer, or geologist proficient in injection well performance. The status report shall document the condition and performance of the injection well system in accordance with the Department's guidelines for an injection well status report. Field inspections and observations for the status report shall be performed at least during the last month of the (3-month) monitoring period. A monitoring and reporting schedule is attached that designates the last months of the monitoring periods. The status report shall be submitted to the Department for review within one month after the end of the designated monitoring period.

(h) Under applicable conditions, the Director shall have the right to order and direct the permittee to collect and analyze special or unscheduled samples of the injectant. Applicable conditions consist of, but are not limited to, accidental discharges, malicious discharges, and undefined discharges into the injection well. The permittee is required to maintain records of the sample collection and analysis in conformance with Part I B. 1. (a) of this permit.

(i) Summary reports, results of scheduled chemical analyses, inspection reports, mechanical integrity reports, or hydrologic monitoring reports shall be submitted to the Department within 60 days after the end of the designated monitoring period for which the submittal applies. Submittals taking longer than 60 days are noncompliant with the 60 day time limit unless a time extension is granted by the Director based on circumstances for the delay. A request for a time extension shall be made at least 10 days before the submittal is due.

2. Accurate, Current, and Representative Information

The submission of records, analytical results, recorded inspections, status reports, and any other reportings as specified and required by this permit shall be accurate, current, and representative of the activity being monitored within the specified time frame for monitoring. The submission of inaccurate, noncurrent, and/or unrepresentative records, results, inspections, reports, and any other required information, or the nonsubmission of the required materials, is a violation of this permit.

3. Reporting of Noncompliance of Injectant Concentrations

The permittee shall notify the Department of any exceedings of or noncompliance with the concentrations or limitations specified in Part I A. 2. Injection Limitations, as determined by the monitoring and analyses specified in this permit. The notification shall consist of a report that shall include the analytical results and an explanation for the exceeding or noncompliance. The report shall be submitted to the Department within fifteen (15) days of knowledge of the exceeding or noncompliance.

4. Emergency Operation

(a) In the event of an emergency operation that results in the discharge of geothermal fluids to a holding system, such as a lined surface impoundment, a daily record of the quantity of fluids being discharged into the holding system shall be kept. The discharge quantity shall be determined by flow measurements of the effluent.

(b) The Department shall be notified within 24 hours of any such discharge to a holding system.

(c) A summary report of the daily discharges to the holding system for every emergency operation shall be submitted to the Department within 15 days after the end of the emergency operation.

(d) The Department shall be notified of the intent to discharge the contents of the holding system into the injection well. Discharge into the injection well shall only occur with the approval of the Director.

(e) Discharge of geothermal injectant to a holding system does not preclude the activities of all sampling, analyses, and reporting conditions of this permit.

5. Additional Monitoring and Reporting

If the operation of the injection wells is additionally regulated by other pollution control programs, e.g., National Pollutant Discharge Elimination System (NPDES), the adherence to those monitoring and reporting conditions shall not be circumvented by the terms and conditions of this permit.

6. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed, and the calibration and maintenance of applicable facility instrumentation, shall be retained on site for a minimum of three (3) years from the date of procurement and shall be made available for inspection by departmental personnel. This period may be extended by the request of the Director at any time.

7. Anticipated Changes

The permittee shall give notice a minimum of 7 days in advance to the Department of any planned changes in the facility or facility's activity which may significantly change any operating characteristics or specifications of the injection wells; or which may result in noncompliance with the permit conditions. Advance notice shall be of sufficient time to allow for the Department's evaluation of planned changes and revision, if necessary, of any term or condition of this permit. Changes, modifications, revisions or construction on the operating characteristics or specifications of the injection wells shall not be implemented unless approved by the Director.

8. Notification of Change in Operator, Ownership, Control, or Facility Name

In the event of any change in operator (permittee), ownership, control, or facility name of the injection wells, the permittee shall report the change to the Department in writing at least one month prior to closing. Until such time as the permit is revoked and/or reissued, the permittee of record shall be responsible for the operation of the wells and for damages resulting from improper operation of the wells.

9. Twenty-Four Hour Reporting

Under any of the following conditions, an oral report is required within 24 hours from the time the permittee becomes aware of the circumstances:

(a) Monitoring, or other information, which indicates that the injection activity is causing or could cause an endangerment to a USDW;

(b) Malfunction of the injection system which causes or could cause fluid migration into, out of, or between geologic formations via the well bore;

(c) Overflow of the injection well;

(d) Discharge into the injection well of prohibited chemical compounds, hazardous wastes, or unauthorized substances;

(e) Impairment of the injection well including and not limited to a collapsed well casing or well bore, well bore obstruction, lost well, or damage to the well resulting in a loss of use; or

(f) Unsafe working or public conditions resulting from the operation of the injection well.

A written report shall also be submitted within five (5) days of the time the permittee becomes aware of the circumstances. The written report shall contain a description of the incident and its cause, including exact dates and times, and if the incident has not been mitigated, the anticipated length of time that it is expected to continue; also, planned or accomplished measures to reduce, eliminate and prevent the reoccurrence of the incident.

Oral reports during the weekday hours of 7:45 a.m. to 4:30 p.m. shall be made to the Safe Drinking Water Branch at (808)586-4258 (Honolulu) or call from Big Island the direct toll free number 974-4000, ext. 64258. For on-island oral reports, the Safe Drinking Water Branch's district sanitarian may be notified at (808)933-0401. For evenings, weekends and holidays, all calls shall be made to (808)247-2191 (Honolulu). The Director may waive the written report and/or the 5-day reporting time limit on a case-by-case basis if the oral report proves satisfactory in meeting the reporting requirements of the written report.

A record shall be kept by the permittee of all incidences subject to oral reporting under this section. Record keeping shall minimally include the nature and cause of the incident, date, time, duration, name of reporting person, and mitigative action.

10. Definitions

(a) The "Department" means the Department of Health, State of Hawaii.

(b) The "Director" means the Director of Health or a duly authorized representative.

(c) "Facility or activity" means any UIC "injection well" or any other facility or activity that is subject to regulation under the UIC Program.

(d) "Fluid" means any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas or any other form or state.

(e) "Injection Pressure" means a pressure measured in pounds per square inch relative to an atmospheric pressure of zero.

(f) "Injection Well" means a well into which subsurface disposal of fluid or fluids occurs or is intended to occur by means of injection.

(g) "USDW" means "underground source of drinking water" as defined in Chapter 11-23.

(h) "Well" means a bored, drilled or driven shaft, or a dug hole, whose depth is greater than its widest surface dimension.

A. MANAGEMENT CONDITIONS:

1. Change in Discharge

All operation of wells authorized herein shall be consistent with the terms and conditions of this permit. The operation of any well identified in this permit at volumes or concentrations in excess of that authorized shall constitute a violation of the permit conditions. Any anticipated facility changes including expansions, production increases, or process modifications which would result in new, different, or increased discharges of injectant shall be reported by submission of a UIC application. If such changes are not expected to violate the injection limitations specified in this permit, such changes may be submitted to the Department in writing instead of a UIC application, whereby the Department will determine if a UIC application would be necessary. Following the written submission of anticipated changes or the submission of a UIC application, this permit may be revoked or modified to specify and limit any injectant not previously authorized by this permit.

2. Signatory Statement

All reports or information submitted to the Department pursuant to this permit shall be signed by the permittee.

3. Availability of Reports

All reports prepared in accordance with the conditions of this permit shall be available for public inspection, with the approval of the Director, at appropriate offices of the Department. Permit applications, permits, and well operation data shall not be considered confidential.

4. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all systems of treatment and control, and related appurtenances, which are installed or used by the permittee to operate the injection wells and to achieve compliance with the conditions of this permit. Proper operation and maintenance include and are not limited to sound engineering principles and practices, effective performance, adequate funding, adequate operator staffing and training, adequate laboratory and process controls, and appropriate quality assurance procedures. Furthermore, effective performance means and is not limited to no contamination of a USDW, no unintended subsurface fluid migration, no injection well overflow, no prohibited discharges, no loss or excessive sedimentation of the injection well, and no creation of unsafe working or public conditions.

5. Permit Reapplication

If the permittee desires to continue an activity regulated by this permit after the expiration date of this permit, reapplication shall be made on appropriate application forms then in use. This reapplication shall be made not later than 180 days before this permit expires in order to facilitate processing of the renewal.

6. Permit Extension

The Director may grant an administrative extension to this permit to authorize the continued operation of the injection wells beyond the permit's expiration date. The administrative extension will at a minimum describe the duration of the administrative extension and the conditions under which the administrative extension is granted.

7. Injection Well Abandonment

Every injection well that is not performing its intended purpose or is determined to be a threat to the groundwater resource shall be abandoned when ordered by the Director.

The permittee who wishes or is ordered to abandon an injection well shall submit an application containing the details of the proposed abandonment at least 60 days before the anticipated start of backfilling work. The Department will review the application and may specify that the injection well be backfilled in a manner which would not allow the infiltration or movement of fluid into, out of, or throughout the well bore. The Department will specify abandonment procedures and provide information for the permittee to complete the Abandonment of Injection Well Summary Report upon completion of backfilling. Abandonment procedures shall also comply with any other applicable regulations including those of the Department of Land and Natural Resources.

B. GENERAL CONDITIONS

1. Operating Conditions

(a) No injection well shall be operated, kept, or otherwise utilized without an active UIC permit issued by the Department.

(b) No person shall construct, operate, maintain, convert, backfill, seal, abandon or conduct any other injection activity in a manner which allows the movement of fluid containing a contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water rule or may otherwise adversely affect the health of one or more persons.

(c) The injection wells shall be operated in such a manner that they do not violate any of Hawaii Administrative Rules, Title 11, regulating various aspects of water quality and pollution, and Chapter 342, HRS. The rules include:

(1) Chapter 11-20, Potable Water Systems.
(2) Chapter 11-55, Water Pollution Control.
(3) Chapter 11-62, Wastewater Systems.

(d) If at any time the Department learns that an injection well may cause a violation of primary drinking water rules, the Director shall order the permittee to take such actions as may be necessary to prevent the violation, including, where required, cessation of operation of the injection well.

(e) Notwithstanding any other condition of this section, the Director will issue an order to immediately cease and desist injection upon receipt of factual information that the injectant has caused or is likely to cause imminent and substantial danger to the health of a person or persons due to contamination of a drinking water source.

2. Permit Issuance

A copy of this permit shall be retained by the permittee and shall be made available for inspection by departmental personnel.

This UIC permit shall not be transferable from the permittee to any other person.

This UIC permit shall be subject to revocation, suspension or revision by the Director if, after notice and opportunity for a contested hearing, it is determined that:

(a) There is a violation of any term or condition of the UIC permit; or

(b) The UIC permit was obtained by misrepresentation, or failure to fully disclose all relevant facts; or

(c) The UIC permit was willfully defaced, altered, forged or falsified; or

(d) There exists a legal, environmental, or public health condition that requires either a temporary or permanent reduction or elimination of the permitted injection; or

(e) There is a failure to comply with Chapter 11-23 or any other applicable rules or laws.

All permit conditions will remain in effect despite the filing of a request by the permittee for a permit revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance.

3. Permit Modification

Any modification, alteration, or change to this permit shall be made only by written supplement or reissuance of the permit by the Department.

5. New Rules and Regulations

The occurrence of new rules and regulations affecting underground injection, typically occurring as amendments to existing rules and regulations, may require that limitations or conditions within the permit be revised accordingly. Revisions to the permit, depending on the nature of the revision, may occur as a written supplement or an administrative reissuance of the permit, or it may require that the permit be reopened, via an application, before reissuance is accomplished.

Existing limitations and conditions within the permit shall not be grounds for superseding new rules and regulations that would otherwise warrant a revision of the permit. The responsibility for knowing about and understanding new, as well as existing, rules and regulations that affect the permit is upon the permittee.

5. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.

6. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

7. Right of Entry

Departmental personnel shall have the right to enter premises on which any injection well system is located; to inspect any equipment, operation, or sampling of any injection well system; to take effluent or injectant samples from any injection well system; and to have access to and copy any record required to be kept pursuant to this permit.

8. Need to Halt or Reduce an Activity not a Defense

It shall not be a defense for a permittee to claim in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

9. Penalties

It shall be a violation of Chapter 11-23 for any person, owner or operator of an injection well to construct, operate, maintain or abandon that injection well unless authorized in writing by the Director. It shall also be a violation of Chapter 11-23 for any permittee to fail to comply with the terms and conditions of this permit including those relating to inspection, monitoring, record keeping, and reporting. Compliance with a corrective order shall not excuse the basic violation. Any person who violates any provision of Chapter 11-23 or the terms and conditions of this permit shall be subject to the penalties provided in section 340E-8, HRS or section 11-23-22, HAR.

10. Severability

The conditions of this permit are severable; if any condition of this permit or the application of any condition of this permit to any circumstance is held invalid, the application of such condition to other circumstances and the remainder of this permit shall not be affected thereby.

A. OTHER CONDITIONS:

1. Hydrologic Monitoring Program

The permitee shall implement the Hydrologic Monitoring Program (HMP) dated May 1999 or as modified with the written approval of the Director. The HMP is described in **Appendix A**. Monitoring results shall be submitted within 60 days after the end of the designated monitoring period.

2. Program for Mechanical Integrity Testing and Monitoring of Injection Wells

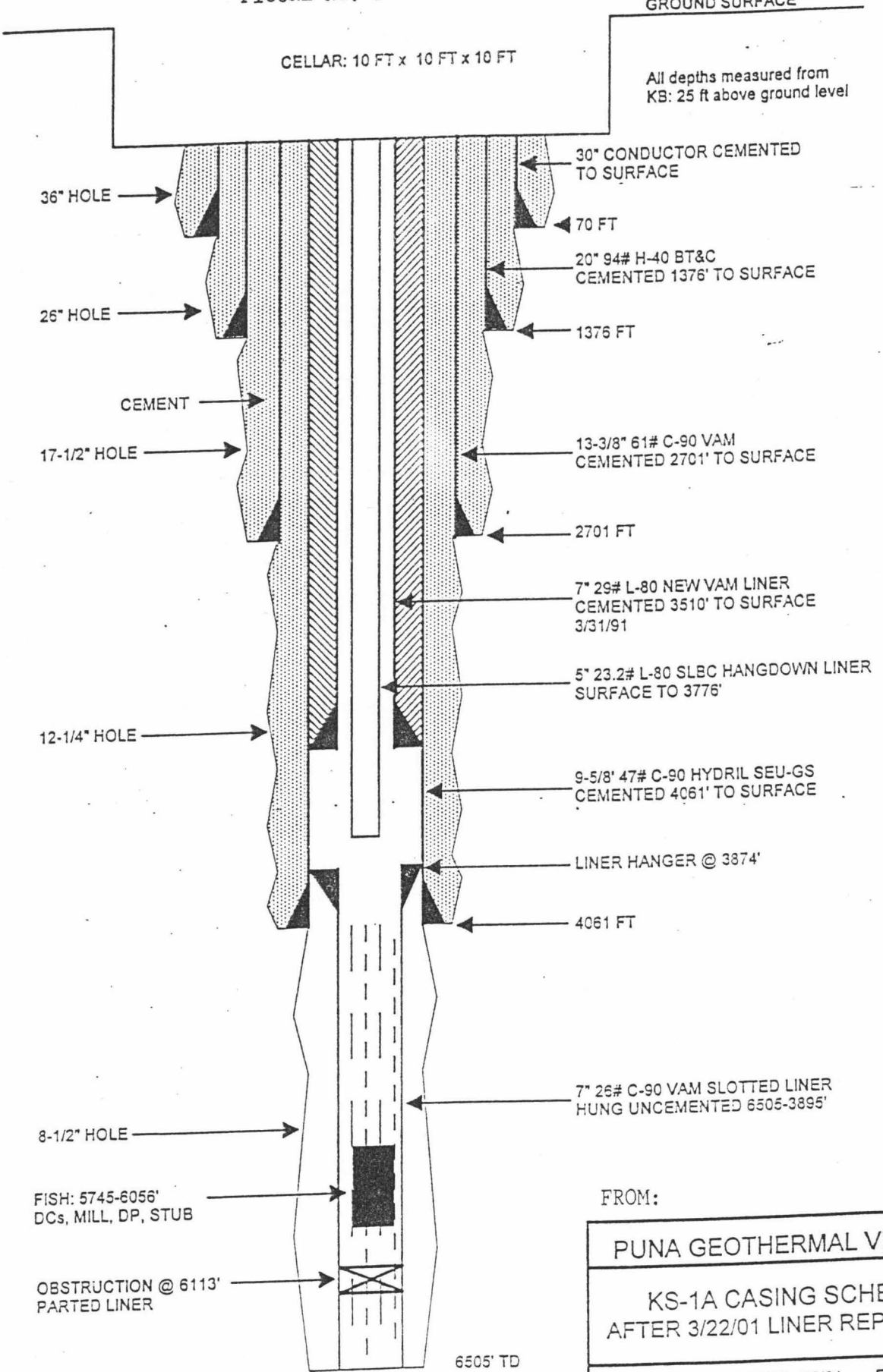
The permittee shall implement the Program for Mechanical Integrity Testing and Monitoring of Injection Wells, dated July 29, 1996, as described in **Appendix B** or as modified with the written approval of the Director. This program shall be implemented for all injection wells, including active, temporarily abandoned (idle), and injection wells converted to monitoring wells.

The permittee shall notify the Department at least forty-five (45) days prior to performing the annual mechanical integrity tests. For mechanical integrity tests resulting from well repair, the permittee will notify the Department as soon as possible to give the Department the option of witnessing the mechanical integrity tests. Test results, findings, and conclusions shall be submitted within 60 days after the end of the designated monitoring period.

3. Modifications to Monitoring and Reporting

This permit herein acknowledges that environmental and facility operating conditions affecting the monitoring and reporting conditions of this permit could warrant the Department's reevaluation of permit conditions in order to address changing concerns and to establish relevant analyses. Modifications to the monitoring and reporting conditions, resulting from reevaluations, shall be approved by the Director before implementation.

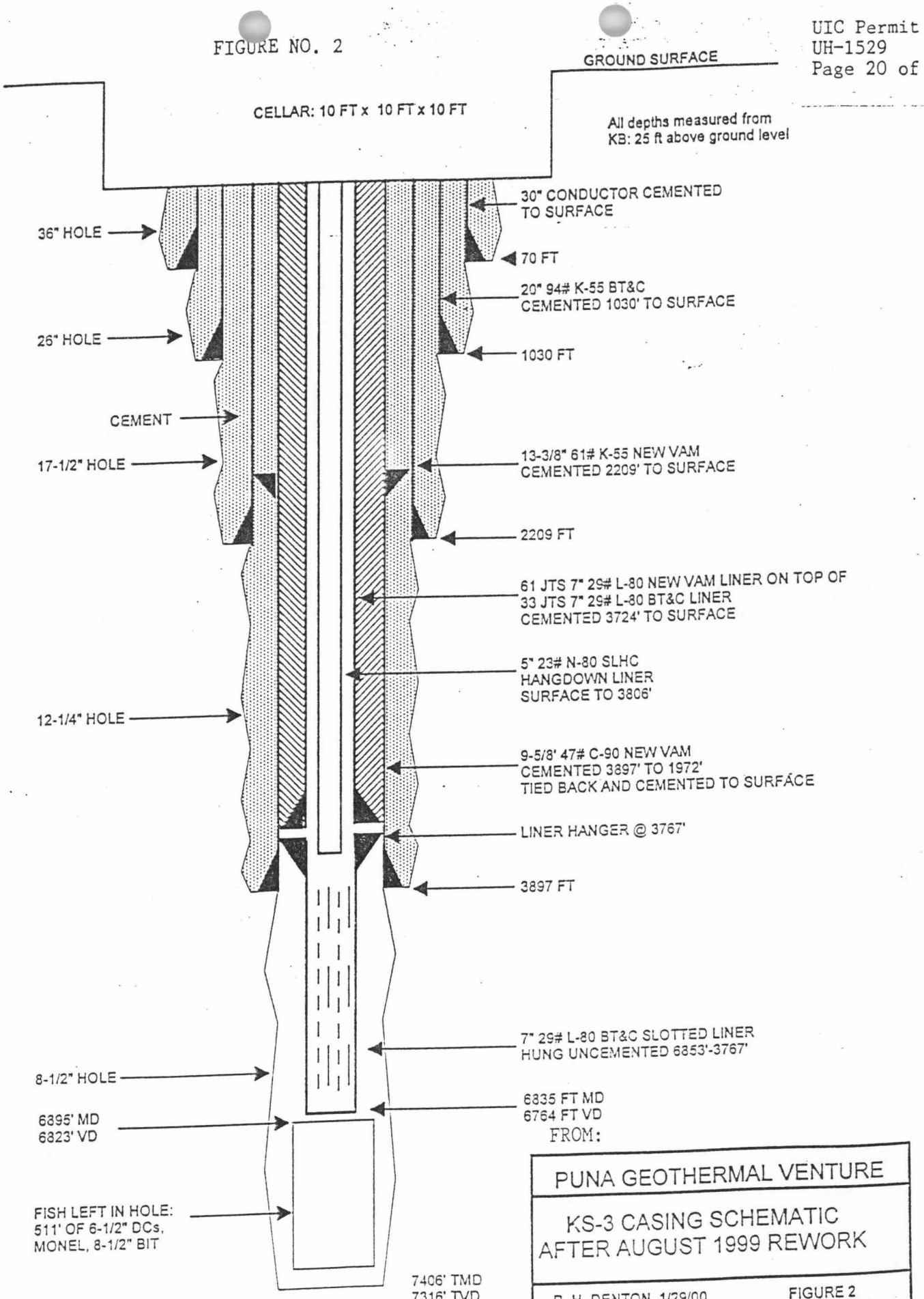
FIGURE NO. 1



FROM:

PUNA GEOTHERMAL VENTURE
KS-1A CASING SCHEMATIC AFTER 3/22/01 LINER REPLACEMENT
GOLDER ASSOCIATES 4/9/01 FIGURE 1

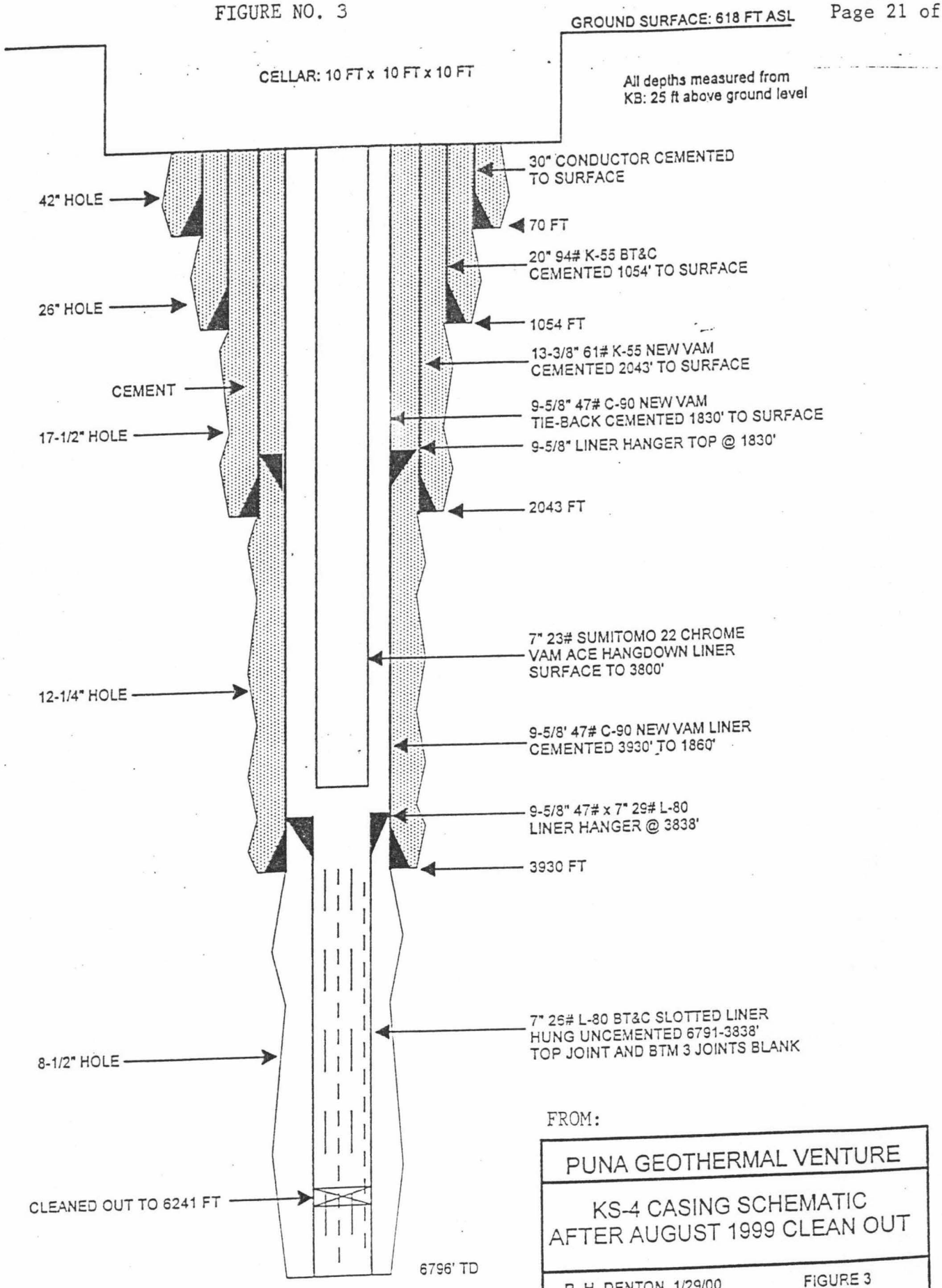
FIGURE NO. 2



FROM:

PUNA GEOTHERMAL VENTURE
KS-3 CASING SCHEMATIC AFTER AUGUST 1999 REWORK
R. H. DENTON 1/29/00 FIGURE 2

FIGURE NO. 3



FROM:

PUNA GEOTHERMAL VENTURE	
KS-4 CASING SCHEMATIC AFTER AUGUST 1999 CLEAN OUT	
R. H. DENTON 1/29/00	FIGURE 3

TABLE NO. 1

CHEMICAL ADDITIVES

PRODUCT NAME AND FUNCTION	CHEMICAL INGREDIENT
Amersite (R)2 Corrosion Inhibitor	Sodium Bisulfite
Wrico Oxy 11 Corrosion Inhibitor	Sodium Sulfite Ethylanediamine Tetraacetic Acid Sodium Salt
WPD 11-306 (Tm) Corrosion Inhibitor	Dimethyldioctylammnonium Chloride Soya Amine Polyethoxylate Cyclohexylamine
West R-322 Corrosion Inhibitor	Polyamideamine Acetate POE (15) Tallow Amine
Midland 203 Oxygen Scavenger	Sodium Metabisulfite Cobalt Compounds
Millsperse (R) 802 Anti-scalant	Poly (Maleic Acid)
Sodium Hydroxide pH Adjustor and H2S Abator	Sodium Hydroxide
Drew 11-480, Corrosion Inhibitor	Soya Amine Polyethoxylate
Royal Purple Barrier Fluid	Synthetic Lubricant
Catalyzed Sulfite Oxygen Scavenger	Sodium Sulfite, Benzoic Acid
Drew 11-575 Anti-Scalant	Sodium Chloride Phosphoric Acid Derivative
Biosperse 250, Microbiocide	Magnesium Nitrate, Cupric Nitrate Magnesium Chloride 2-Methyl-4-Isothiazolin-3-One 5-Chloro-2-Methly-Isothiazolin-3-One
Sulfuric Acid Anti-Scalant	Sulfuric Acid

TABLE NO. 2

TEST PARAMETERS FOR TYPE I SAMPLE

Parameter	Method	Gas Parameter
Arsenic (As)	6010/206	Ammonia (NH3)
Barium (Ba)	6010/208	Argon (Ar)
Boron (B)	200	Carbon Dioxide (CO2)
Cadmium (Cd)	6010/213	Hydrogen (H2)
Calcium (Ca)	6010/215	Hydrogen Sulfide (H2S)
Copper (Cu)	6010/220	Methane (CH4)
Chromium (Cr)	6010/218	Nitrogen (N2)
Iron (Fe)	6010/236	Oxygen (O2)
Lead (Pb)	6010/239	Radon
Lithium (Li)	6010/7430	N-Pentane
Magnesium (Mg)	6010/242	
Manganese (Mn)	6010/243	
Mercury (Hg)	7470/245	
Nickel (Ni)	6010/200	
Potassium (K)	6010/258	
Silver (Ag)	6010/272	
Sodium (Na)	6010/273	
Vanadium (V)	6010/286	
Zinc (Zn)	6010/289	
Bromide	320	
Bicarbonate (HCO3)	310	
Carbonate (CO3)	310	
Chloride	325	
Fluoride	340	
Nitrate (NO3)	352	
Silica (SiO2)	370	
Sulfate (SO4)	375	
Total Sulfur (S)	Various	
Total Alkalinity	310	
Total Dissolved Solids (TDS)	160.1	
Total Suspended Solids (TSS)	160.2	
Oil and Grease	413 or 1664	
Conductivity	120	

All methods listed are EPA or EPA equivalent, unless otherwise noted.

TABLE NO. 3

TEST PARAMETERS FOR TYPE III SAMPLE

Parameter	Regulatory Level (mg/l)	Method As described in 40 CFR (1998):
Ignitability		Part 261.21
Corrosivity		Part 261.22
Reactivity		Part 261.23
Inorganics:		Method 1311 (TCLP),
arsenic	5.0	with appropriate
barium	100.0	methods of analyses
cadmium	1.0	contained in SW-846
chromium	5.0	
lead	5.0	
mercury	0.2	
selenium	1.0	
silver	5.0	
Organics:		1311
benzene	0.5	
carbon tetrachloride	0.5	
chlorobenzene	100.0	
chloroform	6.0	
o-cresol	200.0	
m-cresol	200.0	
p-cresol	200.0	
1,4-dichlorobenzene	7.5	
1,2-dichloroethane	0.5	
1,1-dichloroethylene	0.7	
2,4-dinitrotoluene	0.13	
hexachlorobenzene	0.13	
hexachloro-1,3-butadiene	0.5	
hexachloroethane	3.0	
methyl ethyl ketone	200.0	
nitrobenzene	2.0	
pyridine	5.0	
tetrachloroethylene	0.7	
trichloroethylene	0.5	
2,4,5-trichlorophenol	400.0	
2,4,6-trichlorophenol	2.0	
vinyl chloride	0.2	

TABLE NO. 4

TEST PARAMETERS FOR TYPE IV SAMPLE

Parameter	Method
Volatile Organics	524/624/8240/8260
Benzene	
Bromodichloromethane	
Bromoform	
Bromomethane	
Carbon Tetrachloride	
Chlorobenzene	
Chloroethane	
2-Chloroethylvinyl ether	
Chloroform	
Chloromethane	
Dibromochloromethane	
1,2-Dichlorobenzene	
1,3-Dichlorobenzene	
1,4-Dichlorobenzene	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1 Dichloroethylene	
trans-1,2-Dichloroethene	
1,2-Dichloropropane	
cis-1,3-Dichloropropene	
trans-1,3-Dichloropropene	
Ethyl benzene	
Methylene chloride	
1,1,2,2-Tetrachloroethane	
Tetrachloroethene	
Toluene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethene	
Trichlorofluoromethane	
Vinyl Chloride	

APPENDIX A

PUNA GEOTHERMAL VENTURE

HYDROLOGIC MONITORING PROGRAM

May 1999

Sampling Locations: The following wells will be monitored.

Well Name	Elevation (MSL)	Completion Depth (MSL)
MW-2	588	-2
MW-1	610	-46
GTW-III (standby)	563	-127
Malama Ki (standby)	274	-42

Frequency: Regular sampling shall occur twice a year, once in January and once in July.

Water Level Measurements: Prior to bailing the well and sampling, water level measurements will be taken and recorded using an electronic direct contact detection probe with a calibrated cable/tape for direct measurement at the top of the well casing. Calibrated cable/tape length shall be sufficient to measure water levels in the deepest wells. The metering device shall be equipped with an audible signal and light to indicate water level contact.

Quality Assurance / Quality Control: Quality assurance/quality control procedures will be in compliance with standards of practice for similar programs relative to the acquisition, reduction, verification, and validation of the site data. At each location, standardized equipment cleaning will be conducted prior to obtaining each sample.

Prior to ground water sampling, the well will be bailed at least three times the wellbore volume.

All samples will be taken and field analyses conducted in accordance with standard protocols approved by the EPA. An EPA or State of Hawaii certified laboratory will be used to conduct the analyses for samples submitted. Samples will be transferred from the bailer/sample port directly to appropriately prepared containers supplied by the laboratory. Samples will be labeled stored, and transported in a chilled state in insulated containers to the laboratory.

In the analyses, detection limits will be used that are below

maximum contaminant levels. If they are not, the sampling and analyses will be repeated using the proper detection limits.

The contractor will provide a copy of their Quality Assurance program to DOH and EPA for review and approval.

Physical and Chemical Parameters: Field analyses will include:

- pH
- temperature
- conductivity
- salinity
- chloride
- water level.

These measurements will be obtained by using calibrated instruments specifically designed to directly measure these physical and chemical parameters within the operational constraints dictated by site conditions.

The inorganic and organic constituents to be sampled for are specified in the UIC permit Tables No. 2, 3, and 4.

Reporting: Sampling results and measurements will be submitted during the February following the January sampling, and the August following the July sampling. Original laboratory reports will be included with a cover letter. Reporting units shall be specified. The laboratory shall not use "Below Regulatory Limits" or "BRL" in its reporting, but rather, the actual numerical results will be reported. If "BRL" is used, the sampling and analysis will be redone until numerical results are reported.

Further Monitoring: If leakage of the injectate into the USDW is suspected, groundwater sampling may be modified. Depending on the situation, this could include sampling from Malama Ki and GTW-III, sampling for certain analytes, and more frequent sampling.

APPENDIX B

PUNA GEOTHERMAL VENTURE
PROGRAM FOR MECHANICAL INTEGRITY TESTING AND MONITORING OF INJECTION WELLS
July 29, 1996

1. INTRODUCTION

1.1 Background

Pursuant to Underground Injection Control (UIC) Permit No. HI596002, the U.S. Environmental Protection Agency requires that Puna Geothermal Venture (PGV) comply with this Testing and Monitoring Program (TMP) for injection wells. Monitoring and testing provisions in this TMP are similar in most respects to those in the "Casing Monitoring Program," April 26, 1993 version, which is referenced by title in PGV's current UIC Permit No. UH-1529. **(The Casing Monitoring Program related to Hawaii UIC Permit No. UH-1529 was originally dated 11/21/1991 and amended later dated 4/26/1993.)** It is anticipated that this same TMP will be approved and adopted by the Hawaii Department of Health as a replacement for the 1993 "Casing Monitoring Program." Revisions to testing and monitoring provisions in the 1993 "Casing Monitoring Program" have been made as a result of a joint review of PGV's injection well monitoring and testing involving EPA, BLM (as advisor to EPA), HDOH and PGV. The purpose of these revisions is to better accomplish the goal of protecting the groundwater aquifer under the PGV project site, which is considered to be a USDW. The principle changes in the monitoring and testing procedures are as follows:

- As described in Section 3.1 of this TMP for wells in injection service, the annulus nitrogen pressure will be maintained to keep the nitrogen/water interface at a depth of at least 2000 ft.

The 1993 CMP requires that the nitrogen/water interface be maintained "more than half way down the annulus." Based on a nominal casing depth of 4000 ft., the two criteria are effectively the same.

- In accordance with Section 3.2.1, the annual casing pressure test of each well will be done by depressing the water level to 3000 ft. with nitrogen while the well is on injection. Annulus pressure drop exceeding 10% in five hours will be considered indicative of a leak requiring diagnosis and repair.

  The 1993 CMP specifies that the pressure test be done by depressing the water level to the shoe of the 9-5/8-inch casing with nitrogen (while, by practical necessity, the well is shut in.). An annulus pressure drop exceeding 8% in 30 minutes was considered indicative of a leak requiring diagnosis and repair. The principle difference is the increase in length of the test period from 30 minutes to five hours, which makes the nitrogen pressure test equivalent to a 30-minute test with water.

1.2 Purpose

The purpose of this TMP is to specify the observations, tests, drilling operations and , if necessary, remedial actions required to insure that the mechanical integrity of injection well casing and cement is maintained through the drilling, testing and operation of PGV wells. The cemented and hung casing strings that are used in the PGV wells are designed to prevent contamination of any underground source of drinking water (USDW) by injected fluids. Contamination of the USDW's might occur if the casing strings are breached due to corrosion or mechanical failure or if there is a failure of the cement to seal the casing/borehole annulus between the casing shoe and the lowermost USDW. The testing and monitoring program described below is designed to detect and diagnose a loss of mechanical integrity in the casing or cement.

Remedial actions required to restore mechanical integrity are also described.

1.3 Scope

This TMP covers all injection wells on the 500-acre PGV site.

2. TESTING DURING DRILLING AND COMPLETION

2.1 Pressure Testing During Drilling

Each injection well is completed with three casing strings (not including the 30-inch conductor pipe) cemented to the surface (Figure 1). Upon completion of cementing each casing string and prior to drilling out the cement shoe, the casing well be pressure tested. The DLNR will be notified at least 24 hours before each test for the opportunity to witness it. The test will consist of pressurizing the casing with water or drilling mud to a specified test pressure and monitoring the pressure for 30 minutes with the well shut-in. The minimum casing test pressure shall be approximately one-third of the internal yield pressure rating, provided that the test pressure shall not be less than 600 psig nor greater than 2500 psig. In cases where combination strings or liners are involved, the above test pressures shall apply to the lowest pressure-rated casing. The pressure drop during the 30-minute period shall not exceed 10% of the test pressure.

In the event of a pressure loss exceeding the above criterion, one or more of the following diagnostic methods will be used to locate the leak:

- Temperature log while injecting
- Shut-in temperature survey
- Casing inspection logs with multi-arm caliper and/or magnetic inspection tools
- Pressure testing with a packer(s) on drillpipe
- Other applicable methods

After identification of the point of leakage, a cement squeeze job will be performed and the casing retested.

After a successful pressure test of each casing string, drilling will proceed to a point at least one foot below the casing shoe, and a pressure leak-off test will be performed to test the integrity of the annular cement. Each test will be performed at a pressure approaching the fracturing pressure of the exposed formation. If there is excessive leak-off, a squeeze cement job will be performed, the cement will be drilled out and the test will be repeated. Drilling will not proceed until an effective cement seal is established in the casing/borehole annulus above the casing shoe. In some situations, such as the case where there is natural formation permeability immediately below the casing shoe, it may not be practical to prove cement integrity with the pressure test described above. As an alternative, a standard water shutoff test (WSO) may be done above the shoe, or shut-in temperature surveys may be run.

2.2 Logs and Surveys During Injection Testing

Upon completion of drilling and prior to installation of the hangdown liner, a water injection test may be performed, if needed, to obtain a preliminary evaluation of the well. During such a test, one or more of the following logs or surveys may be run:

- TPS or T/P logs through the open hole and cased intervals with the well on injection; or

- Shut-in temperature survey(s) before and/or after injection.

If any of these logs or surveys indicates a loss of mechanical integrity, the problem will be diagnosed, and repair procedures will be performed in accordance with Section 2.3.

2.3 Casing Repair

Once a loss of mechanical integrity is identified and approximately located, casing repair procedures will be initiated. These procedures may include any or all of the following activities:

2.3.1 Shut in well and run magnetic and multi-arm casing inspection logging tools to locate the leak and to evaluate the casing condition.

2.3.2 Rig up workover rig on well. Run packer(s) on drillpipe and pressure test to confirm suspected leaking interval.

2.3.3 Execute cement squeeze job to seal casing leak or stop interzonal flows behind casing.

2.3.4 Perform casing pressure test and other diagnostic tests as necessary to confirm success of the remedial work. If good, move rig off well and return well to injection service.

2.3.5 In the event of major casing failure, a cemented liner may be installed through the damaged interval.

2.3.6 Prior to drilling out the liner shoe, the liner will be pressure tested as described in Section 2.1.

2.3.7 If mechanical integrity cannot be restored satisfactorily, the well will be plugged and abandoned.

3. MONITORING AND TESTING AFTER WELL IS PLACED IN SERVICE

3.1 Continuous Monitoring During Routine Injection Operations

During routine injection well operations, including brief periods when well(s) may be temporarily out of service, the following conditions will be maintained:

3.1.1 A continuous recording of the following parameters will be maintained for each well:

* Injection wellhead pressure,
* Annulus (nitrogen) pressure, and
* Injection flow rate.

These parameters shall be recorded on a graphical chart which shows their relationship to elapsed time. Plant operators will take daily readings at each well.

3.1.2 The annular space between the hangdown liner and cemented casing will be pressurized with nitrogen, and the pressure will be monitored and recorded in accordance with Section 3..1. above. The annulus will be repressurized with nitrogen as necessary to maintain the nitrogen/water interface at a depth of 2000 ft KB (1975 ft below ground level) or deeper. some loss of nitrogen pressure is normal, and occasional repressurization will be required. If the rate of nitrogen pressure decline is such that it is impractical to maintain the required minimum pressure, it will be considered indicative of a leak requiring diagnosis and repair.

3.2 Annual Testing

Once annually, tests and surveys will be conducted to verify mechanical integrity of the hangdown liner. The casing and hangdown liner will be tested for leaks by one of the following procedures, or a combination thereof.

3.2.1 Perform a pump-down test on the annulus between the hangdown liner and the cemented casing. The test will be done with the well on injection at normal operating flow rate and wellhead pressure, or higher.

or

3.2.2 If the hangdown liner is pulled, the casing may be pressure tested above a bridge plug or packer set near the shoe following the basic procedure outlined in Section 2.1. Integrity of the hangdown liner may be verified by inspection on the surface, by a pressure test (with nitrogen) after it is run in the hole, or by a TPS log with the well on injection.

Integrity of the cement (external mechanical integrity) will be checked during each workover by one or more of the following procedures:

3.2.3 One or more shut-in static temperature surveys will be run. Shut-in time will be at least 12 hours, or longer if necessary to obtain meaningful results.

or

3.2.4 Other logs or surveys may be run, at the discretion of PGV, if static temperature surveys are not definitive.

3.3 Restoration of Mechanical Integrity or Abandonment

In the event that the diagnostic procedures indicate a loss of mechanical integrity, remedial or abandonment procedures will be carried out as specified in Section 2.3.

MONITORING AND REPORTING SCHEDULE

UIC PERMIT NO. :

UH-1529

PERMIT ISSUED:

10/20/01

PERMIT EXPIRES:

08/24/05

\ SCHEDULED

X COMPLETED

MONTH	TYPE I	TYPE III	TYPE IV	REPORT OF ANALYTICAL RESULTS ★	STATUS REPORT	MONTH	TYPE I	TYPE III	TYPE IV	REPORT OF ANALYTICAL RESULTS ★	STATUS REPORT
10/01						10/04					
11/01	\			\		11/04	\			\	
12/01					\	12/04					\
01/02	\	\	\	\		01/05	\	\	\	\	
02/02						02/05					
03/02	\			\	\	03/05	\			\	\
04/02						04/05					
05/02	\			\		05/05	\			\	
06/02					\	06/05					\
07/02	\	\	\	\		07/05	\	\	\	\	
08/02						08/05					
09/02	\			\	\						
10/02											
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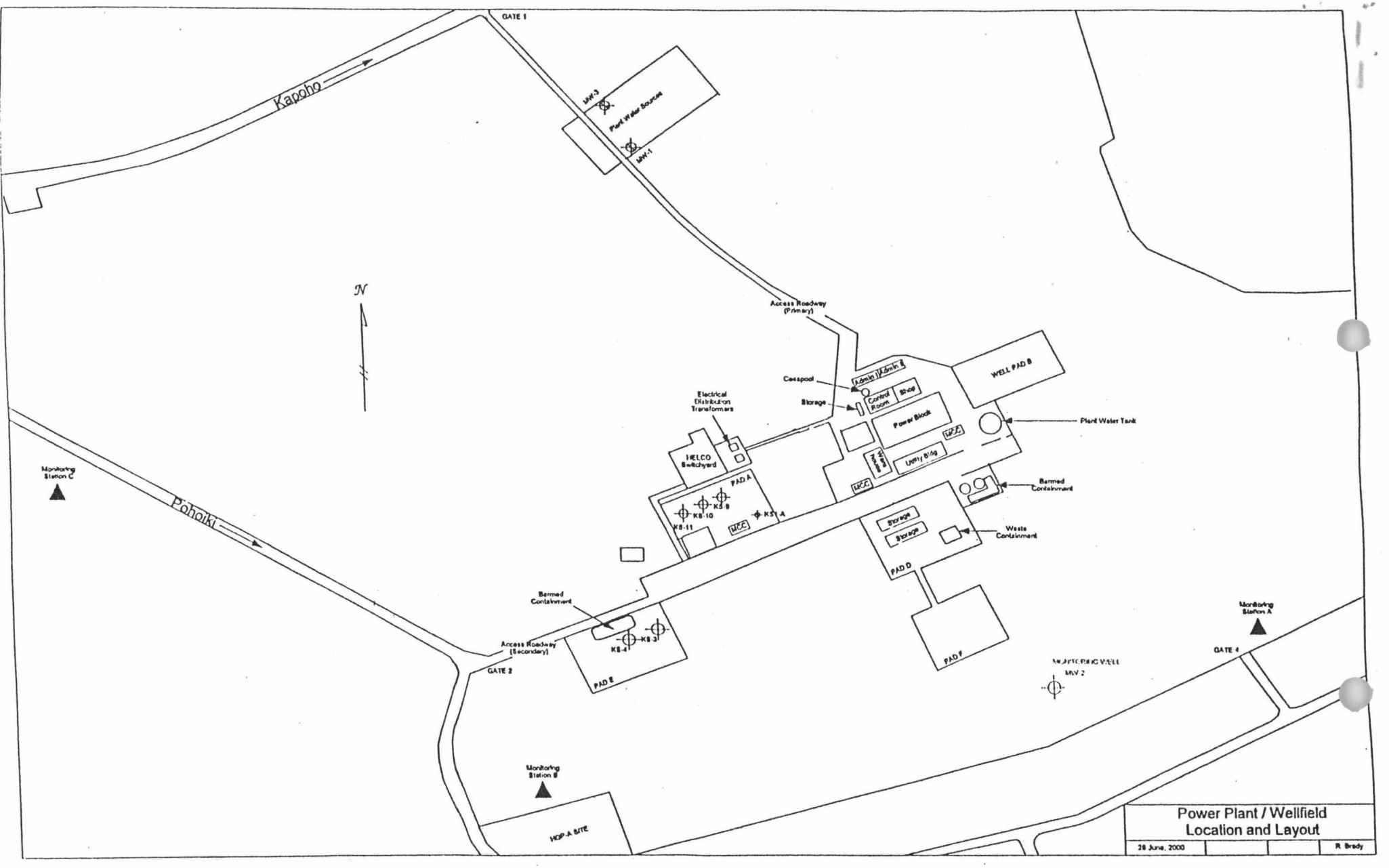
★ Submit original laboratory report with chain of custody form for the scheduled month's analyses within 60 days after the end of the designated monitoring period.



INJECTION WELL LOCATION PLAN

PUNA GEOTHERMAL VENTURE

14-3860 Kapoho Pahoa Road, Pahoa, Hawai'i

UIC Permit No. UH-1529

39921

OMKM Engr. Br.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O.BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD/SDWB

October 24, 2001

10002UCH.01

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778

Dear Mr. Mizuno:

SUBJECT: PUNA GEOTHERMAL VENTURE (PGV)
UNDERGROUND INJECTION CONTROL (UIC)
UIC PERMIT APPLICATION FOR NEW INJECTION WELLS
UIC PERMIT APPLICATION NO. UH-1529A

We have completed the review of your preliminary application for new injection well construction and have determined that the conditions for the granting-of-approval to construct up to seven (7) injection wells at the subject facility have been satisfied. Therefore, you are hereby granted approval to construct the seven injection wells.

This approval to construct is based on the plans and information that were provided in the PGV preliminary application dated August 13, 1997, the public hearing held on April 3, 1998 at Pahoa High School, and the U.S. Environmental Protection Agency's UIC Individual Permit, Class V Injection, Permit No. HI596002 issued on August 25, 2000 to PGV. Any modifications to the proposed injection wells, their operation or manner in which injection is to occur, subsequent to this approval, shall require our approval before implementation. Any modifications conducted without our approval will constitute a violation of Chapter 11-23.

This approval to construct is valid for a time period of 180 calendar days from the date of this letter. You are required to notify us verbally and in writing at least 7 days before starting construction activities. Unless construction is started within the 180-day time period, this approval to construct will be void. If construction is expected to occur after the 180-day time period, you are required to ask in writing for a time extension at least 30 days before the expiration of this approval. Copies of this approval and the preliminary application shall be kept at the construction site, where practicable.

This approval to construct does not constitute a permit to operate the injection facility upon completion of construction. Depending on the data obtained during construction, a permit to operate may or may not be issued.

Pursuant to Section 11-23-13, as amended, please submit your final application documents consisting of a certified engineering report prepared by a geologist and professional engineer in accordance with the enclosed "Final Report Format For New or Modified Injection Well." This submittal should be made as soon as possible following the construction and testing of the injection wells to expedite the final processing of your UIC permit application.

You are required to notify Chauncey Hew of the Safe Drinking Water Branch two weeks prior to the injection well testing. You will be informed if departmental personnel will be present to witness the injection well testing. If you conduct the injection well test without notifying the department, you will be required to redo the injection well test under proper witnessing.

If you have any questions about the final application document, or the processing of your application, please call Chauncey Hew of the Safe Drinking Water Branch at 586-4258 or call direct toll free from Big Island at 974-4000, ext. 64258.

Sincerely,

GARY GILL, DEPUTY DIRECTOR
Environmental Health Administration

CH:chl

Enclosure: Final Report Format for New or Modified Injection Well

c:
1. Glenn Tomori, Sanitarian, East Hawaii (w/encl.)
2. Mr. Christopher Yuen, Director, Planning Department, Hawaii County (w/encl.)
3. Mr. Gil S. Coloma-Agaran, Chairman, DLNR (w/encl.)
4. Dr. Seiji Naya, Director, DBEDT (w/encl.)
5. Ms. Laura Tom Bose, Chief
   Ground Water Office
   USEPA, Region 9 (w/encl.)

FINAL REPORT FORMAT FOR NEW OR MODIFIED INJECTION WELL UNDERGROUND INJECTION CONTROL (UIC)

UIC APPLICATION NO. UH-1529A UIC PERMIT NO. UH-1529

1. General Information:
   - a) Facility name;
   - b) Name and address of Operator and Owner.

2. Physical Characteristics of the Area:
   - a) Location and accessibility;
   - b) Climate;
   - c) Topography;
   - d) Geologic and foundation conditions;
   - e) Earthquake considerations;
   - f) Flood potential including tsunami inundation zones;
   - g) Conformance with local land-use planning and zoning regulations;
   - h) Sensitive environments: natural or community-related.

3. Injection Well System:
   - a) Actual number of injection wells constructed or modified;
   - b) Date of construction or modification;
   - c) Security from unauthorized access;
   - d) Site plan (drawn to scale) showing location of constructed or modified injection well(s);
   - c) Description of any changes from the permit application.

4. Hydrogeologic Characteristics:
   - a) Well log (geologic profile) by geologist:
     - (1) Lithology of injection intervals and confining formations that incorporate descriptive terminologies for soil and rock;
     - (2) Physical and structural characteristics of the formations encountered. The following characteristics shall be used in the descriptions: color, hardness (competency), degree of weathering, qualitative degree of fracturing or consolidation, qualitative degree of vesiculation or porosity, unified soil classification for soils, volcanic series or lithologic formation for rock, petrologic terminologies for rock and cinder, lava type, and the differentiation between soil and rock units;

b) Injection testing:

(1) Minimum 12 hours of continuous injection testing for all wells. Furthermore, the duration of injection testing should accommodate all test objectives satisfactorily in order to insure safe and proper long-term injection well operations.

(2) Complete results of injection testing including maximum injection capacity of the well and hydraulic conductivity of the injection formation;

c) Groundwater characteristics:

(1) Initial water level, and subsequent water level as fluctuations occur;

(2) Tidal fluctuations and tidal efficiency;

(3) Continuous total dissolved solids and/or salinity profile for all wells, representatively taken before the introduction of any foreign fluids. The profiles shall represent stabilized conditions without influence or restriction from any well casing for new well construction and shall extend to the bottom of the boring. Profiles within solid casing strings are not acceptable for new injection well construction;

(4) Water samples and analytical results from the following levels: at the water table, at the top of injection interval, at the bottom of boring, midway between water table and top of injection interval, and midway between top of injection internal and bottom of boring or;

Water samples and analytical results from each distinct zone of significantly different total dissolved solids or salinity concentration levels.

Water samples shall be analyzed using EPA or EPA equivalent standards and methods for the following parameters:

Parameter	EPA Method
chlorides	325
conductivity (specific conductance)	120
dissolved oxygen	360
field pH	150
field temperature	170
Total Dissolved Solids	160

5. Special considerations to be addressed by this report: For item No. 4, water sampling will be affected by whether the injection well is being newly constructed or converted from a well of prior use. Depending on the circumstance, water sample collection and testing criteria shall be confirmed by the Department before implementation in order to establish relevant objectives and results.

6. Attach an original Signatory and Certification Statement sheet signed and dated by the operator or legal representative of the facility.

7. Preparers' signature: The final report shall be signed by the geologist and licensed engineer and shall bear the engineer's stamp.

Engr. Br.

3992

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O.BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD/SDWB

October 24, 2001

10003UCH.01

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778

Dear Mr. Mizuno:

SUBJECT: PUNA GEOTHERMAL VENTURE
UNDERGROUND INJECTION CONTROL (UIC)
UIC PERMIT RENEWAL
UIC PERMIT NO. UH-1529

We have completed the review of your UIC permit-renewal application and have determined that the conditions required for the approval to operate three injection wells at the subject facility have been satisfied. Therefore, you are hereby granted approval to operate the three injection wells under the terms and conditions of the enclosed State UIC permit.

Your facility and injection wells have retained the following identification numbers:

UIC Permit No. UH-1529
Facility ID No. 8-2883.01
Wells No. KS-1A, KS-3, and KS-4

Please refer to the UIC permit number in all future correspondence with this office.

Failure to comply with the terms and conditions of the permit will constitute a violation of the permit. Any person who violates the permit's terms and conditions or any provision of Hawaii Administrative Rules, Title 11, Chapter 23, Underground Injection Control, as amended, shall be subject to the penalties provided in Section 340E-8, Hawaii Revised Statutes, as amended.

Please review and pay special attention to Part I B. "Monitoring and Reporting Conditions." Under this section, you are responsible for monitoring, record keeping, and reporting conditions. Noncompliance to this section well result in a violation of the UIC permit. Please contact us if you have any questions pursuant to this section.

Please note that the conditions of your State UIC permit closely parallel many of the conditions of your Federal UIC permit issued by the U.S. Environmental Protection Agency on August 25, 2000. For example, monitoring and reporting parameters, pressure requirements, scheduling of events, and the duration of the permits are some identical elements of both the State and Federal UIC permits. If any inconsistency between the State and Federal UIC permit arises, all parties shall confer for a resolution.

If you have any questions about your permit or the UIC program, please call Chauncey Hew of the Safe Drinking Water Branch at 586-4258 or call direct toll free from Big Island at 974-4000, ext. 64258.

Sincerely,

GARY GILL, DEPUTY DIRECTOR
Environmental Health Administration

CH:chl

Enclosure: State UIC Permit No. UH-1529

c:
1. Glenn Tomori, Sanitarian, East Hawaii (w/encl.)
2. Mr. Christopher Yuen, Director, Planning Department, Hawaii County (w/encl.)
3. Mr. Gil S. Coloma-Agaran, Chairman, DLNR (w/encl.)
4. Dr. Seiji Naya, Director, DBEDT (w/encl.)
5. Ms. Laura Tom Bose, Chief, Ground Water Office
   USEPA, Region 9 (w/encl.)

STATE OF HAWAII

DEPARTMENT OF HEALTH

UNDERGROUND INJECTION CONTROL (UIC)

PERMIT NO. UH-1529

FACILITY IDENTIFICATION NO. 8-2883.01

for

PUNA GEOTHERMAL VENTURE

Operated By
COSI Puna, Inc.

TABLE OF CONTENTS

Appendices

AUTHORIZATION TO OPERATE UNDER THE UNDERGROUND INJECTION CONTROL PROGRAM

In compliance with the provisions of the Safe Drinking Water Act, Chapter 340E, Hawaii Revised Statutes (HRS), as amended, and Hawaii Administrative Rules (HAR), Title 11, Chapter 23, Underground Injection Control, as amended;

PUNA GEOTHERMAL VENTURE
Operated by
COSI Puna, Inc.

is authorized to operate a Class V, Subclass E, injection well system consisting of three (3) injection wells known as geothermal wells Kapoho State 1A (KS-1A), Kapoho State 3 (KS-3), and Kapoho State 4 (KS-4):

Injection Well No.	Located on Well Pad	Approx. Well Head Elevation Above Mean Sea Level
KS-1A	A	617 Feet
KS-3	E	618 Feet
KS-4	E	618 Feet

and having the specifications as listed in Figure No. 1, Figure No. 2, and Figure No. 3, respectively; to inject the geothermal fluids consisting of geothermal brine, geothermal steam condensate, and geothermal noncondensible gases which are produced during the operation of the well field and power plant; and the intermittent inclusion of injection supplement water; back into the geothermal reservoir at an interval between the approximate depths of 3,900 feet and 7,300 feet, in reference to the Kelly Bushing;

located at the facility's address of 14-3860 Kapoho Pahoa Road, Pahoa, Hawaii 96778 at Tax Key Number, 3rd Div. 1-4-01:2 and 19; at the approximate well pad coordinates:

Well Pad A: Latitude 19° 28' 49" N and Longitude 154° 53' 35" W;
Well Pad E: Latitude 19° 28' 41" N and Longitude 154° 53' 40" W;

under Facility Identification Number: 8-2883.01.1-3;

in accordance with monitoring conditions, and other terms and conditions set forth in Parts I, II, and III hereof.

This permit becomes effective upon issuance.

This permit and the authorization to operate the three (3) injection wells will expire at midnight, August 24, 2005.

Issued on the 20th day of October 2001.

(For) Director of Health

A. OPERATING CONDITIONS:

1. Injectant Characteristics

Injectant in this permit is limited to geothermal fluids consisting of geothermal brine, geothermal steam condensate, geothermal noncondensible gases, chemical additives for well casing corrosion, scale and biofouling control, tracers, and injection supplemental water, that may include the chemical parameters listed in **Table No. 1**.

2. Injection Limitations and Prohibitions

(a) Injectant in this permit is exclusively limited to the injectant described in Part I A.1. above; furthermore, any injectant not described in Part I A.1. is explicitly prohibited unless the injectant characteristics of this permit are revised accordingly.

(b) No discharge of hazardous wastes as defined by Title 40, Code of Federal Regulations (CFR), Part 261.

(c) Injection Pressure:

The maximum injection pressure as measured at the well head shall not exceed 500 psi gauge or the fracture pressure of the receiving formation, whichever is less.

(d) Annular Pressure:

Annular nitrogen pressure for all injection wells shall be constantly maintained to depress the nitrogen/water interface to a depth of at least 2000 feet, relative to the kelly bushing, approximately 1975 feet below ground surface.

(e) Concentrations of the Injectant

Chemical and physical analyses are required as detailed in Part I B. 1. (c) of this permit to determine the chemical concentration levels and/or the physical nature of the injectant. Chemical analyses in Part I B. 1. (c) may include analyses that are capable of analyzing the injectant for the characteristics of a hazardous waste, for volatile organic compounds, or for dissolved nutrients associated with the processes of eutrophication.

Certain chemical and/or physical parameters may be specified in this permit with an Action Level, a Regulatory Level, or both. Regulatory Levels shall not be exceeded. Chemical and/or physical parameters with or without specified Action Levels or Regulatory Levels may be subject to revised concentration levels pursuant to changing concerns related to public or environmental health, safety, or relevant laws and regulations.

B. MONITORING AND REPORTING CONDITIONS:

1. Injectant and Injection Well Monitoring

(a) Injectant samples, measurements, and analyses taken or conducted as required by this permit shall be valid and representative of the volume and nature of the injectant. Pursuant to the monitoring and reporting conditions of this permit, detailed records of the operation of the injection wells shall be kept by the permittee. When applicable, records shall include at a minimum the following information:

(1) Type of injectant.
(2) Quantity of injectant.
(3) The method of injection.
(4) Injection pressure.
(5) The rate of injection.
(6) The operational status of the injection well.
(7) The exact date and time of the measurement or sampling.
(8) The person(s) who performed the measurement or sampling.
(9) The dates the analyses were performed.
(10) The person(s) who performed the analyses.
(11) The analytical techniques or methods used.
(12) The results of all required analyses and permit limits.
(13) Chain of Custody.

(b) A daily record of the injectant quantity (gpd) being discharged into each injection well shall be kept. Injectant quantity recordings shall be continuously made through a direct measurement of the wastestream or by a method approved by the Director. A **monthly** summary giving the daily amounts of injectant for each well shall be submitted to the Department.

A continuous recording of the injection pressure (psig) and annular pressure at the well head shall be kept. Pressure recordings shall be documented on a graphical chart, such as a strip chart or circular chart, or log that shows the relationship between pressure and elapse time. A **monthly** summary giving the daily injection and annular pressures for each well shall be submitted to the Department. The annular pressures shall be compared against the calculated required pressure to maintain the proper depth of the nitrogen/water interface.

A daily record of the injectant temperature being discharged into each injection well shall be maintained. Injectant temperature recordings shall be continuously monitored and recorded. A **monthly** summary giving the daily average injection temperature for each well shall be submitted to the Department.

The use of injection supplemental water discharged into the injection wells shall be recorded. The recording shall be directly and continuously made to measure the flow of supplemental water. A **monthly** summary giving the daily amounts of supplemental water used shall be submitted to the Department.

Chemical additions being used for corrosion, scale, and biofouling control shall be recorded. The record shall account for the daily, weekly, and monthly consumptive amounts of each chemical. A **monthly** summary giving the monthly consumptive amount of each chemical shall be submitted to the Department.

(c) Representative grab samples (three types: Types I, III, and IV) of the injectant shall be collected from a collection point to be established by the permittee and approved by the Director. The permittee shall collect and analyze the samples and report the analytical results according to the conditions and the Monitoring and Reporting Schedule of this permit. The collection and analysis of the samples shall be conducted by a laboratory acceptable to the Director. If the laboratory is unable to perform the sample collection, the Director may allow the permittee to collect the sample under the direction of the laboratory.

All samples shall be collected, transported, preserved, stored, documented, analyzed, and reported in accordance with EPA or EPA equivalent methods or standards, and all such activities shall be performed properly and satisfactorily in order to produce valid samples and analytical results. The falsification, fabrication, tampering, or improper handling and management of the samples, chain-of-custody form, or analytical results shall be a violation of this permit.

Methods of analysis shall be as stated herein or approved by the Director. The frequency of sample collection and the type of analyses are as described:

Type I Sample:

(1) Type I samples shall be collected and analyzed at least once every two months. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.

(2) Type I samples shall be analyzed for the test parameters listed in **Table No. 2**.

(3) Type I samples shall be collected between the hours of 9 a.m. and 3 p.m.

(4) The analytical results from this phase of analysis (Type I) shall be submitted to the Department and a copy shall be kept on file at the facility.

Type III Sample:

(1) Type III samples shall be collected and analyzed at least once every six months in conjunction with Type I samples. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.

(2) Type III samples shall be analyzed for Ignitability, Corrosivity, Reactivity, and Method 1311: Toxicity Characteristic Leaching Procedure (TCLP) as described in 40 CFR, Part 261, Appendix II. Reference is hereby made to **Table No. 3** which lists the test parameters for which the analysis shall be conducted under Method 1311. Regulatory levels of the chemical parameters are listed for reference.

(3) Type III samples shall be collected between the hours of 9 a.m. and 3 p.m.

(4) The analytical results from this phase of analysis (Type III) shall be submitted to the Department and a copy shall be kept on file at the facility.

Type IV Sample:

(1) Type IV samples shall be collected and analyzed at least once every six months in conjunction with Type I and III samples. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.

(2) Type IV samples shall be analyzed for volatile organic compounds as described in 40 CFR, Part 136, Appendix A, Method 624. Reference is hereby made to **Table No. 4** which lists the test parameters and the analytical methods.

(3) Type IV samples shall be collected between the hours of 9 a.m. and 3 p.m.

(4) The analytical results from this phase of analysis (Type IV) shall be submitted to the Department and a copy shall be kept on file at the facility.

(d) The collection of Type III and Type IV samples shall be witnessed by departmental personnel unless a waiver to this condition is granted by the Director. The permittee shall notify the Department at least seven (7) days prior to the date of sample collection for this phase of analysis. Any Type III and Type IV samples that are collected without the acknowledgement and inspection by departmental personnel, unless waived by the Director, will not serve to comply with the monitoring and reporting conditions of this permit.

(e) Every exceeding of an Action Level or Regulatory Level concentration shall prompt an immediate (within five (5) days from the time of knowledge of the initial analytical results) resampling for and reanalysis of the particular exceeding test parameter. If a Risk-Based Corrective Action or an Oily Wastewater-related action level is exceeded, the reanalysis shall be conducted by using the same method. If a TCLP-related action level is exceeded, the reanalysis shall be conducted by using Method 1311: TCLP as described in 40 CFR, Part 261, Appendix II. If a TCLP regulatory level is exceeded, the reanalysis shall be conducted by using the same method.

The permittee shall immediately notify the Department of every exceeding of an Action Level or Regulatory Level concentration and shall submit the original and follow-up analytical results. The Department may impose additional conditions on resampling and reanalysis.

(f) A periodic recorded inspection of the injection well system at least once every week shall be conducted by the permittee. The inspection shall include the recordation of the operational status of the injection well system to detect any deterioration of the injection well system and associated operations that might lead to an injection well failure, and provide the opportunity to correct any occurrence of prohibited discharge activity. The person conducting the periodic inspection shall be knowledgeable of what is unlawful disposal of chemical compounds, petroleum products and other hazardous substances into the injection well. If such activities are encountered, the permittee shall take immediate action to alleviate, correct, clean up, and record such disposal incidents. The recorded inspection including any disposal incidents shall be kept at the facility and be made available for inspection by departmental personnel.

(g) A periodic status report shall be completed at least **once every 3 months** regarding the condition and performance of the injection well system. The status report shall be made by a professional consultant, engineer, or geologist proficient in injection well performance. The status report shall document the condition and performance of the injection well system in accordance with the Department's guidelines for an injection well status report. Field inspections and observations for the status report shall be performed at least during the last month of the (3-month) monitoring period. A monitoring and reporting schedule is attached that designates the last months of the monitoring periods. The status report shall be submitted to the Department for review within one month after the end of the designated monitoring period.

(h) Under applicable conditions, the Director shall have the right to order and direct the permittee to collect and analyze special or unscheduled samples of the injectant. Applicable conditions consist of, but are not limited to, accidental discharges, malicious discharges, and undefined discharges into the injection well. The permittee is required to maintain records of the sample collection and analysis in conformance with Part I B. 1. (a) of this permit.

(i) Summary reports, results of scheduled chemical analyses, inspection reports, mechanical integrity reports, or hydrologic monitoring reports shall be submitted to the Department within 60 days after the end of the designated monitoring period for which the submittal applies. Submittals taking longer than 60 days are noncompliant with the 60 day time limit unless a time extension is granted by the Director based on circumstances for the delay. A request for a time extension shall be made at least 10 days before the submittal is due.

2. Accurate, Current, and Representative Information

The submission of records, analytical results, recorded inspections, status reports, and any other reportings as specified and required by this permit shall be accurate, current, and representative of the activity being monitored within the specified time frame for monitoring. The submission of inaccurate, noncurrent, and/or unrepresentative records, results, inspections, reports, and any other required information, or the nonsubmission of the required materials, is a violation of this permit.

3. Reporting of Noncompliance of Injectant Concentrations

The permittee shall notify the Department of any exceedings of or noncompliance with the concentrations or limitations specified in Part I A. 2. Injection Limitations, as determined by the monitoring and analyses specified in this permit. The notification shall consist of a report that shall include the analytical results and an explanation for the exceeding or noncompliance. The report shall be submitted to the Department within fifteen (15) days of knowledge of the exceeding or noncompliance.

4. Emergency Operation

(a) In the event of an emergency operation that results in the discharge of geothermal fluids to a holding system, such as a lined surface impoundment, a daily record of the quantity of fluids being discharged into the holding system shall be kept. The discharge quantity shall be determined by flow measurements of the effluent.

(b) The Department shall be notified within 24 hours of any such discharge to a holding system.

(c) A summary report of the daily discharges to the holding system for every emergency operation shall be submitted to the Department within 15 days after the end of the emergency operation.

(d) The Department shall be notified of the intent to discharge the contents of the holding system into the injection well. Discharge into the injection well shall only occur with the approval of the Director.

(e) Discharge of geothermal injectant to a holding system does not preclude the activities of all sampling, analyses, and reporting conditions of this permit.

5. Additional Monitoring and Reporting

If the operation of the injection wells is additionally regulated by other pollution control programs, e.g., National Pollutant Discharge Elimination System (NPDES), the adherence to those monitoring and reporting conditions shall not be circumvented by the terms and conditions of this permit.

6. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed, and the calibration and maintenance of applicable facility instrumentation, shall be retained on site for a minimum of three (3) years from the date of procurement and shall be made available for inspection by departmental personnel. This period may be extended by the request of the Director at any time.

7. Anticipated Changes

The permittee shall give notice a minimum of 7 days in advance to the Department of any planned changes in the facility or facility's activity which may significantly change any operating characteristics or specifications of the injection wells; or which may result in noncompliance with the permit conditions. Advance notice shall be of sufficient time to allow for the Department's evaluation of planned changes and revision, if necessary, of any term or condition of this permit. Changes, modifications, revisions or construction on the operating characteristics or specifications of the injection wells shall not be implemented unless approved by the Director.

8. Notification of Change in Operator, Ownership, Control, or Facility Name

In the event of any change in operator (permittee), ownership, control, or facility name of the injection wells, the permittee shall report the change to the Department in writing at least one month prior to closing. Until such time as the permit is revoked and/or reissued, the permittee of record shall be responsible for the operation of the wells and for damages resulting from improper operation of the wells.

9. Twenty-Four Hour Reporting

Under any of the following conditions, an oral report is required within 24 hours from the time the permittee becomes aware of the circumstances:

(a) Monitoring, or other information, which indicates that the injection activity is causing or could cause an endangerment to a USDW;

(b) Malfunction of the injection system which causes or could cause fluid migration into, out of, or between geologic formations via the well bore;

(c) Overflow of the injection well;

(d) Discharge into the injection well of prohibited chemical compounds, hazardous wastes, or unauthorized substances;

(e) Impairment of the injection well including and not limited to a collapsed well casing or well bore, well bore obstruction, lost well, or damage to the well resulting in a loss of use; or

(f) Unsafe working or public conditions resulting from the operation of the injection well.

A written report shall also be submitted within five (5) days of the time the permittee becomes aware of the circumstances. The written report shall contain a description of the incident and its cause, including exact dates and times, and if the incident has not been mitigated, the anticipated length of time that it is expected to continue; also, planned or accomplished measures to reduce, eliminate and prevent the reoccurrence of the incident.

Oral reports during the weekday hours of 7:45 a.m. to 4:30 p.m. shall be made to the Safe Drinking Water Branch at (808)586-4258 (Honolulu) or call from Big Island the direct toll free number 974-4000, ext. 64258. For on-island oral reports, the Safe Drinking Water Branch's district sanitarian may be notified at (808)933-0401. For evenings, weekends and holidays, all calls shall be made to (808)247-2191 (Honolulu). The Director may waive the written report and/or the 5-day reporting time limit on a case-by-case basis if the oral report proves satisfactory in meeting the reporting requirements of the written report.

A record shall be kept by the permittee of all incidences subject to oral reporting under this section. Record keeping shall minimally include the nature and cause of the incident, date, time, duration, name of reporting person, and mitigative action.

10. Definitions

(a) The "Department" means the Department of Health, State of Hawaii.

(b) The "Director" means the Director of Health or a duly authorized representative.

(c) "Facility or activity" means any UIC "injection well" or any other facility or activity that is subject to regulation under the UIC Program.

(d) "Fluid" means any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas or any other form or state.

(e) "Injection Pressure" means a pressure measured in pounds per square inch relative to an atmospheric pressure of zero.

(f) "Injection Well" means a well into which subsurface disposal of fluid or fluids occurs or is intended to occur by means of injection.

(g) "USDW" means "underground source of drinking water" as defined in Chapter 11-23.

(h) "Well" means a bored, drilled or driven shaft, or a dug hole, whose depth is greater than its widest surface dimension.

A. MANAGEMENT CONDITIONS:

1. Change in Discharge

All operation of wells authorized herein shall be consistent with the terms and conditions of this permit. The operation of any well identified in this permit at volumes or concentrations in excess of that authorized shall constitute a violation of the permit conditions. Any anticipated facility changes including expansions, production increases, or process modifications which would result in new, different, or increased discharges of injectant shall be reported by submission of a UIC application. If such changes are not expected to violate the injection limitations specified in this permit, such changes may be submitted to the Department in writing instead of a UIC application, whereby the Department will determine if a UIC application would be necessary. Following the written submission of anticipated changes or the submission of a UIC application, this permit may be revoked or modified to specify and limit any injectant not previously authorized by this permit.

2. Signatory Statement

All reports or information submitted to the Department pursuant to this permit shall be signed by the permittee.

3. Availability of Reports

All reports prepared in accordance with the conditions of this permit shall be available for public inspection, with the approval of the Director, at appropriate offices of the Department. Permit applications, permits, and well operation data shall not be considered confidential.

4. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all systems of treatment and control, and related appurtenances, which are installed or used by the permittee to operate the injection wells and to achieve compliance with the conditions of this permit. Proper operation and maintenance include and are not limited to sound engineering principles and practices, effective performance, adequate funding, adequate operator staffing and training, adequate laboratory and process controls, and appropriate quality assurance procedures. Furthermore, effective performance means and is not limited to no contamination of a USDW, no unintended subsurface fluid migration, no injection well overflow, no prohibited discharges, no loss or excessive sedimentation of the injection well, and no creation of unsafe working or public conditions.

5. Permit Reapplication

If the permittee desires to continue an activity regulated by this permit after the expiration date of this permit, reapplication shall be made on appropriate application forms then in use. This reapplication shall be made not later than 180 days before this permit expires in order to facilitate processing of the renewal.

6. Permit Extension

The Director may grant an administrative extension to this permit to authorize the continued operation of the injection wells beyond the permit's expiration date. The administrative extension will at a minimum describe the duration of the administrative extension and the conditions under which the administrative extension is granted.

7. Injection Well Abandonment

Every injection well that is not performing its intended purpose or is determined to be a threat to the groundwater resource shall be abandoned when ordered by the Director.

The permittee who wishes or is ordered to abandon an injection well shall submit an application containing the details of the proposed abandonment at least 60 days before the anticipated start of backfilling work. The Department will review the application and may specify that the injection well be backfilled in a manner which would not allow the infiltration or movement of fluid into, out of, or throughout the well bore. The Department will specify abandonment procedures and provide information for the permittee to complete the Abandonment of Injection Well Summary Report upon completion of backfilling. Abandonment procedures shall also comply with any other applicable regulations including those of the Department of Land and Natural Resources.

B. GENERAL CONDITIONS

1. Operating Conditions

(a) No injection well shall be operated, kept, or otherwise utilized without an active UIC permit issued by the Department.

(b) No person shall construct, operate, maintain, convert, backfill, seal, abandon or conduct any other injection activity in a manner which allows the movement of fluid containing a contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water rule or may otherwise adversely affect the health of one or more persons.

(c) The injection wells shall be operated in such a manner that they do not violate any of Hawaii Administrative Rules, Title 11, regulating various aspects of water quality and pollution, and Chapter 342, HRS. The rules include:

(1) Chapter 11-20, Potable Water Systems.
(2) Chapter 11-55, Water Pollution Control.
(3) Chapter 11-62, Wastewater Systems.

(d) If at any time the Department learns that an injection well may cause a violation of primary drinking water rules, the Director shall order the permittee to take such actions as may be necessary to prevent the violation, including, where required, cessation of operation of the injection well.

(e) Notwithstanding any other condition of this section, the Director will issue an order to immediately cease and desist injection upon receipt of factual information that the injectant has caused or is likely to cause imminent and substantial danger to the health of a person or persons due to contamination of a drinking water source.

2. Permit Issuance

A copy of this permit shall be retained by the permittee and shall be made available for inspection by departmental personnel.

This UIC permit shall not be transferable from the permittee to any other person.

This UIC permit shall be subject to revocation, suspension or revision by the Director if, after notice and opportunity for a contested hearing, it is determined that:

(a) There is a violation of any term or condition of the UIC permit; or

(b) The UIC permit was obtained by misrepresentation, or failure to fully disclose all relevant facts; or

(c) The UIC permit was willfully defaced, altered, forged or falsified; or

(d) There exists a legal, environmental, or public health condition that requires either a temporary or permanent reduction or elimination of the permitted injection; or

(e) There is a failure to comply with Chapter 11-23 or any other applicable rules or laws.

All permit conditions will remain in effect despite the filing of a request by the permittee for a permit revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance.

3. Permit Modification

Any modification, alteration, or change to this permit shall be made only by written supplement or reissuance of the permit by the Department.

5. New Rules and Regulations

The occurrence of new rules and regulations affecting underground injection, typically occurring as amendments to existing rules and regulations, may require that limitations or conditions within the permit be revised accordingly. Revisions to the permit, depending on the nature of the revision, may occur as a written supplement or an administrative reissuance of the permit, or it may require that the permit be reopened, via an application, before reissuance is accomplished.

Existing limitations and conditions within the permit shall not be grounds for superseding new rules and regulations that would otherwise warrant a revision of the permit. The responsibility for knowing about and understanding new, as well as existing, rules and regulations that affect the permit is upon the permittee.

5. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.

6. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

7. Right of Entry

Departmental personnel shall have the right to enter premises on which any injection well system is located; to inspect any equipment, operation, or sampling of any injection well system; to take effluent or injectant samples from any injection well system; and to have access to and copy any record required to be kept pursuant to this permit.

8. Need to Halt or Reduce an Activity not a Defense

It shall not be a defense for a permittee to claim in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

9. Penalties

It shall be a violation of Chapter 11-23 for any person, owner or operator of an injection well to construct, operate, maintain or abandon that injection well unless authorized in writing by the Director. It shall also be a violation of Chapter 11-23 for any permittee to fail to comply with the terms and conditions of this permit including those relating to inspection, monitoring, record keeping, and reporting. Compliance with a corrective order shall not excuse the basic violation. Any person who violates any provision of Chapter 11-23 or the terms and conditions of this permit shall be subject to the penalties provided in section 340E-8, HRS or section 11-23-22, HAR.

10. Severability

The conditions of this permit are severable; if any condition of this permit or the application of any condition of this permit to any circumstance is held invalid, the application of such condition to other circumstances and the remainder of this permit shall not be affected thereby.

A. OTHER CONDITIONS:

1. Hydrologic Monitoring Program

The permitee shall implement the Hydrologic Monitoring Program (HMP) dated May 1999 or as modified with the written approval of the Director. The HMP is described in **Appendix A**. Monitoring results shall be submitted within 60 days after the end of the designated monitoring period.

2. Program for Mechanical Integrity Testing and Monitoring of Injection Wells

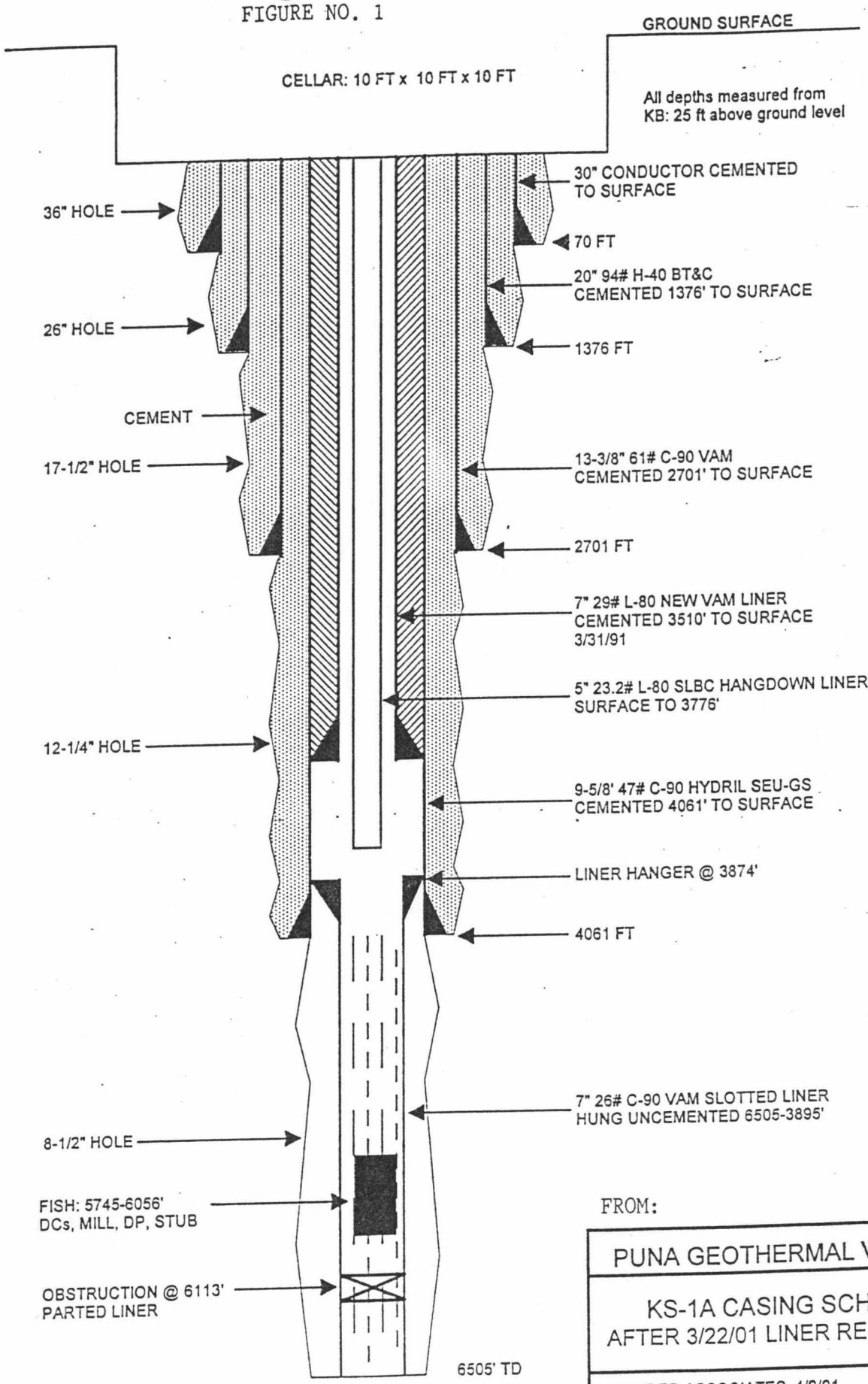
The permittee shall implement the Program for Mechanical Integrity Testing and Monitoring of Injection Wells, dated July 29, 1996, as described in **Appendix B** or as modified with the written approval of the Director. This program shall be implemented for all injection wells, including active, temporarily abandoned (idle), and injection wells converted to monitoring wells.

The permittee shall notify the Department at least forty-five (45) days prior to performing the annual mechanical integrity tests. For mechanical integrity tests resulting from well repair, the permittee will notify the Department as soon as possible to give the Department the option of witnessing the mechanical integrity tests. Test results, findings, and conclusions shall be submitted within 60 days after the end of the designated monitoring period.

3. Modifications to Monitoring and Reporting

This permit herein acknowledges that environmental and facility operating conditions affecting the monitoring and reporting conditions of this permit could warrant the Department's reevaluation of permit conditions in order to address changing concerns and to establish relevant analyses. Modifications to the monitoring and reporting conditions, resulting from reevaluations, shall be approved by the Director before implementation.

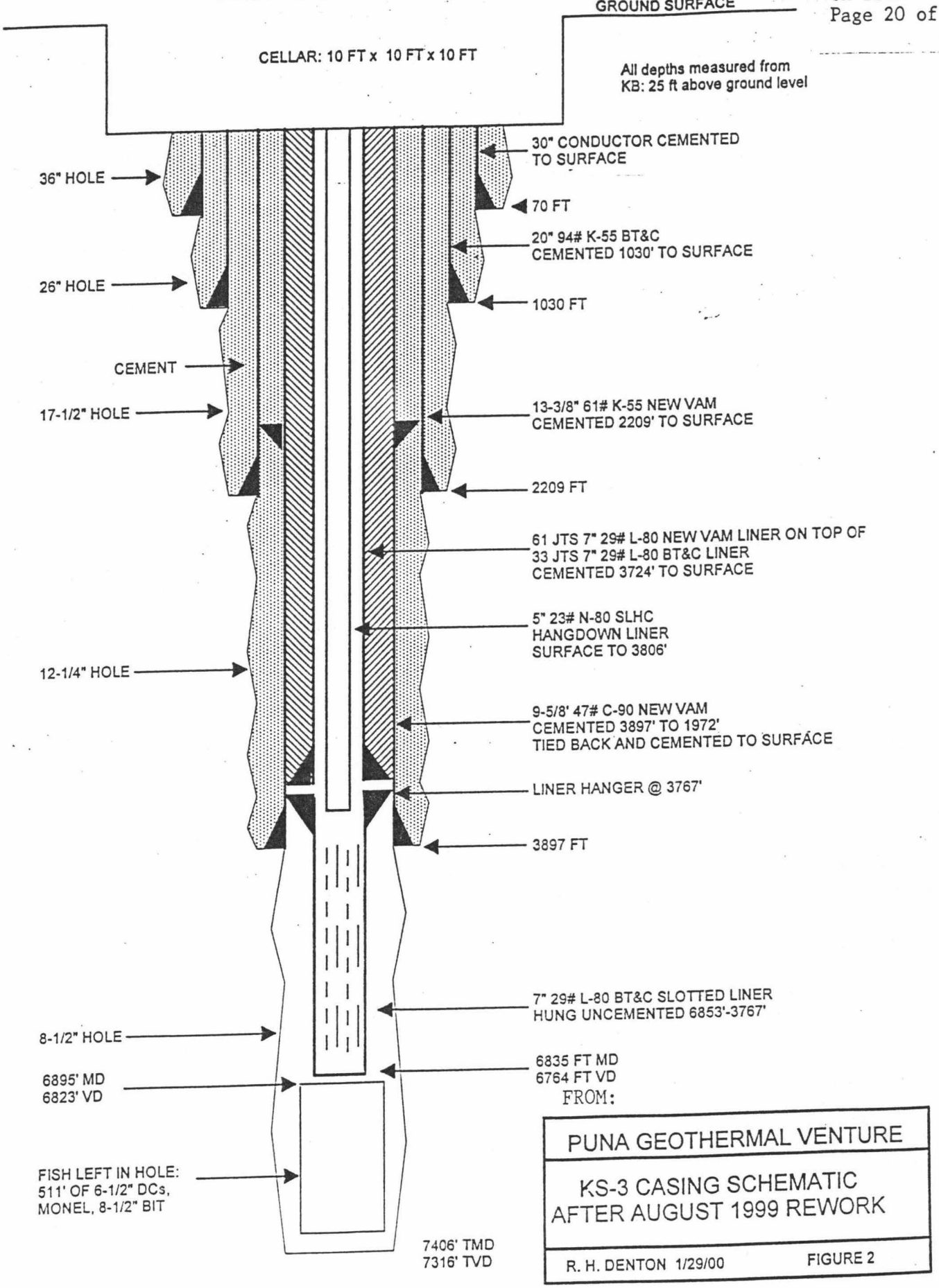
FIGURE NO. 1



FROM:

PUNA GEOTHERMAL VENTURE
KS-1A CASING SCHEMATIC AFTER 3/22/01 LINER REPLACEMENT
GOLDER ASSOCIATES 4/9/01 FIGURE 1

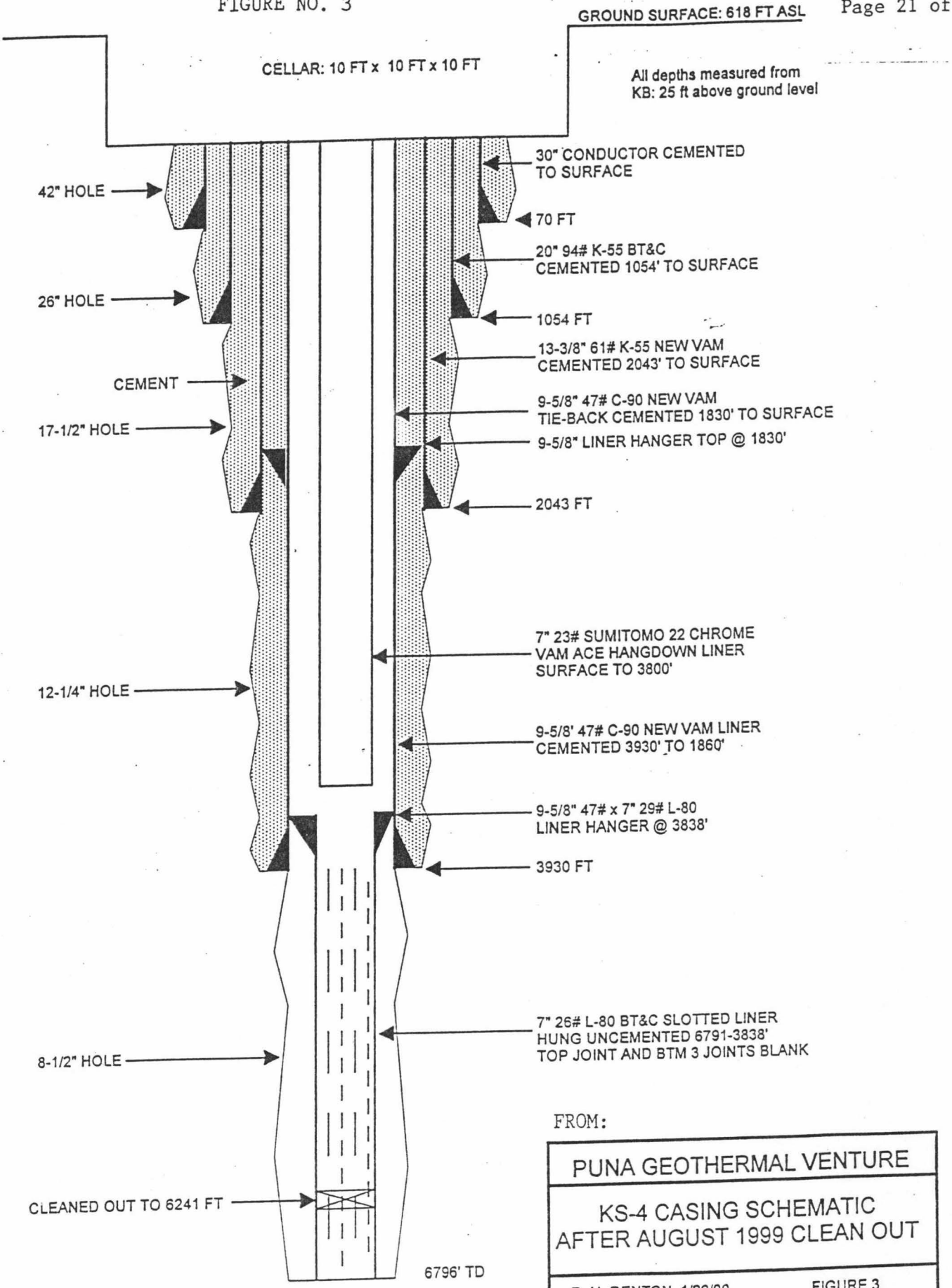
FIGURE NO. 2



FROM:

PUNA GEOTHERMAL VENTURE
KS-3 CASING SCHEMATIC AFTER AUGUST 1999 REWORK
R. H. DENTON 1/29/00 FIGURE 2

FIGURE NO. 3



FROM:

PUNA GEOTHERMAL VENTURE
KS-4 CASING SCHEMATIC AFTER AUGUST 1999 CLEAN OUT
R. H. DENTON 1/29/00 FIGURE 3

TABLE NO. 1

CHEMICAL ADDITIVES

PRODUCT NAME AND FUNCTION	CHEMICAL INGREDIENT
Amersite (R)2 Corrosion Inhibitor	Sodium Bisulfite
Wrico Oxy 11 Corrosion Inhibitor	Sodium Sulfite Ethylanediamine Tetraacetic Acid Sodium Salt
WPD 11-306 (Tm) Corrosion Inhibitor	Dimethyldioctylammnonium Chloride Soya Amine Polyethoxylate Cyclohexylamine
West R-322 Corrosion Inhibitor	Polyamideamine Acetate POE (15) Tallow Amine
Midland 203 Oxygen Scavenger	Sodium Metabisulfite Cobalt Compounds
Millsperse (R) 802 Anti-scalant	Poly (Maleic Acid)
Sodium Hydroxide pH Adjustor and H2S Abator	Sodium Hydroxide
Drew 11-480, Corrosion Inhibitor	Soya Amine Polyethoxylate
Royal Purple Barrier Fluid	Synthetic Lubricant
Catalyzed Sulfite Oxygen Scavenger	Sodium Sulfite, Benzoic Acid
Drew 11-575 Anti-Scalant	Sodium Chloride Phosphoric Acid Derivative
Biosperse 250, Microbiocide	Magnesium Nitrate, Cupric Nitrate Magnesium Chloride 2-Methyl-4-Isothiazolin-3-One 5-Chloro-2-Methly-Isothiazolin-3-One
Sulfuric Acid Anti-Scalant	Sulfuric Acid

TABLE NO. 2

TEST PARAMETERS FOR TYPE I SAMPLE

Parameter	Method	Gas Parameter
Arsenic (As)	6010/206	Ammonia (NH3)
Barium (Ba)	6010/208	Argon (Ar)
Boron (B)	200	Carbon Dioxide (CO2)
Cadmium (Cd)	6010/213	Hydrogen (H2)
Calcium (Ca)	6010/215	Hydrogen Sulfide (H2S)
Copper (Cu)	6010/220	Methane (CH4)
Chromium (Cr)	6010/218	Nitrogen (N2)
Iron (Fe)	6010/236	Oxygen (O2)
Lead (Pb)	6010/239	Radon
Lithium (Li)	6010/7430	N-Pentane
Magnesium (Mg)	6010/242	
Manganese (Mn)	6010/243	
Mercury (Hg)	7470/245	
Nickel (Ni)	6010/200	
Potassium (K)	6010/258	
Silver (Ag)	6010/272	
Sodium (Na)	6010/273	
Vanadium (V)	6010/286	
Zinc (Zn)	6010/289	
Bromide	320	
Bicarbonate (HCO3)	310	
Carbonate (CO3)	310	
Chloride	325	
Fluoride	340	
Nitrate (NO3)	352	
Silica (SiO2)	370	
Sulfate (SO4)	375	
Total Sulfur (S)	Various	
Total Alkalinity	310	
Total Dissolved Solids (TDS)	160.1	
Total Suspended Solids (TSS)	160.2	
Oil and Grease	413 or 1664	
Conductivity	120	

All methods listed are EPA or EPA equivalent, unless otherwise noted.

TABLE NO. 3

TEST PARAMETERS FOR TYPE III SAMPLE

Parameter	Regulatory Level (mg/l)	Method
		As described in 40 CFR (1998):
Ignitability		Part 261.21
Corrosivity		Part 261.22
Reactivity		Part 261.23
Inorganics:		Method 1311 (TCLP), with appropriate methods of analyses contained in SW-846
arsenic	5.0	
barium	100.0	
cadmium	1.0	
chromium	5.0	
lead	5.0	
mercury	0.2	
selenium	1.0	
silver	5.0	
Organics:		1311
benzene	0.5	
carbon tetrachloride	0.5	
chlorobenzene	100.0	
chloroform	6.0	
o-cresol	200.0	
m-cresol	200.0	
p-cresol	200.0	
1,4-dichlorobenzene	7.5	
1,2-dichloroethane	0.5	
1,1-dichloroethylene	0.7	
2,4-dinitrotoluene	0.13	
hexachlorobenzene	0.13	
hexachloro-1,3-butadiene	0.5	
hexachloroethane	3.0	
methyl ethyl ketone	200.0	
nitrobenzene	2.0	
pyridine	5.0	
tetrachloroethylene	0.7	
trichloroethylene	0.5	
2,4,5-trichlorophenol	400.0	
2,4,6-trichlorophenol	2.0	
vinyl chloride	0.2	

TABLE NO. 4

TEST PARAMETERS FOR TYPE IV SAMPLE

Parameter	Method
Volatile Organics	524/624/8240/8260
Benzene	
Bromodichloromethane	
Bromoform	
Bromomethane	
Carbon Tetrachloride	
Chlorobenzene	
Chloroethane	
2-Chloroethylvinyl ether	
Chloroform	
Chloromethane	
Dibromochloromethane	
1,2-Dichlorobenzene	
1,3-Dichlorobenzene	
1,4-Dichlorobenzene	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1 Dichloroethylene	
trans-1,2-Dichloroethene	
1,2-Dichloropropane	
cis-1,3-Dichloropropene	
trans-1,3-Dichloropropene	
Ethyl benzene	
Methylene chloride	
1,1,2,2-Tetrachloroethane	
Tetrachloroethene	
Toluene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethene	
Trichlorofluoromethane	
Vinyl Chloride	

APPENDIX A

PUNA GEOTHERMAL VENTURE

HYDROLOGIC MONITORING PROGRAM

May 1999

Sampling Locations: The following wells will be monitored.

Well Name	Elevation (MSL)	Completion Depth (MSL)
MW-2	588	-2
MW-1	610	-46
GTW-III (standby)	563	-127
Malama Ki (standby)	274	-42

Frequency: Regular sampling shall occur twice a year, once in January and once in July.

Water Level Measurements: Prior to bailing the well and sampling, water level measurements will be taken and recorded using an electronic direct contact detection probe with a calibrated cable/tape for direct measurement at the top of the well casing. Calibrated cable/tape length shall be sufficient to measure water levels in the deepest wells. The metering device shall be equipped with an audible signal and light to indicate water level contact.

Quality Assurance / Quality Control: Quality assurance/quality control procedures will be in compliance with standards of practice for similar programs relative to the acquisition, reduction, verification, and validation of the site data. At each location, standardized equipment cleaning will be conducted prior to obtaining each sample.

Prior to ground water sampling, the well will be bailed at least three times the wellbore volume.

All samples will be taken and field analyses conducted in accordance with standard protocols approved by the EPA. An EPA or State of Hawaii certified laboratory will be used to conduct the analyses for samples submitted. Samples will be transferred from the bailer/sample port directly to appropriately prepared containers supplied by the laboratory. Samples will be labeled stored, and transported in a chilled state in insulated containers to the laboratory.

In the analyses, detection limits will be used that are below

maximum contaminant levels. If they are not, the sampling and analyses will be repeated using the proper detection limits.

The contractor will provide a copy of their Quality Assurance program to DOH and EPA for review and approval.

Physical and Chemical Parameters: Field analyses will include:

- pH
- temperature
- conductivity
- salinity
- chloride
- water level.

These measurements will be obtained by using calibrated instruments specifically designed to directly measure these physical and chemical parameters within the operational constraints dictated by site conditions.

The inorganic and organic constituents to be sampled for are specified in the UIC permit Tables No. 2, 3, and 4.

Reporting: Sampling results and measurements will be submitted during the February following the January sampling, and the August following the July sampling. Original laboratory reports will be included with a cover letter. Reporting units shall be specified. The laboratory shall not use "Below Regulatory Limits" or "BRL" in its reporting, but rather, the actual numerical results will be reported. If "BRL" is used, the sampling and analysis will be redone until numerical results are reported.

Further Monitoring: If leakage of the injectate into the USDW is suspected, groundwater sampling may be modified. Depending on the situation, this could include sampling from Malama Ki and GTW-III, sampling for certain analytes, and more frequent sampling.

APPENDIX B

PUNA GEOTHERMAL VENTURE
PROGRAM FOR MECHANICAL INTEGRITY TESTING AND MONITORING OF INJECTION WELLS
July 29, 1996

1. INTRODUCTION

1.1 Background

Pursuant to Underground Injection Control (UIC) Permit No. HI596002, the U.S. Environmental Protection Agency requires that Puna Geothermal Venture (PGV) comply with this Testing and Monitoring Program (TMP) for injection wells. Monitoring and testing provisions in this TMP are similar in most respects to those in the "Casing Monitoring Program," April 26, 1993 version, which is referenced by title in PGV's current UIC Permit No. UH-1529. **(The Casing Monitoring Program related to Hawaii UIC Permit No. UH-1529 was originally dated 11/21/1991 and amended later dated 4/26/1993.)** It is anticipated that this same TMP will be approved and adopted by the Hawaii Department of Health as a replacement for the 1993 "Casing Monitoring Program." Revisions to testing and monitoring provisions in the 1993 "Casing Monitoring Program" have been made as a result of a joint review of PGV's injection well monitoring and testing involving EPA, BLM (as advisor to EPA), HDOH and PGV. The purpose of these revisions is to better accomplish the goal of protecting the groundwater aquifer under the PGV project site, which is considered to be a USDW. The principle changes in the monitoring and testing procedures are as follows:

- As described in Section 3.1 of this TMP for wells in injection service, the annulus nitrogen pressure will be maintained to keep the nitrogen/water interface at a depth of at least 2000 ft.

The 1993 CMP requires that the nitrogen/water interface be maintained "more than half way down the annulus." Based on a nominal casing depth of 4000 ft., the two criteria are effectively the same.

- In accordance with Section 3.2.1, the annual casing pressure test of each well will be done by depressing the water level to 3000 ft. with nitrogen while the well is on injection. Annulus pressure drop exceeding 10% in five hours will be considered indicative of a leak requiring diagnosis and repair.

  The 1993 CMP specifies that the pressure test be done by depressing the water level to the shoe of the 9-5/8-inch casing with nitrogen (while, by practical necessity, the well is shut in.). An annulus pressure drop exceeding 8% in 30 minutes was considered indicative of a leak requiring diagnosis and repair. The principle difference is the increase in length of the test period from 30 minutes to five hours, which makes the nitrogen pressure test equivalent to a 30-minute test with water.

1.2 Purpose

The purpose of this TMP is to specify the observations, tests, drilling operations and , if necessary, remedial actions required to insure that the mechanical integrity of injection well casing and cement is maintained through the drilling, testing and operation of PGV wells. The cemented and hung casing strings that are used in the PGV wells are designed to prevent contamination of any underground source of drinking water (USDW) by injected fluids. Contamination of the USDW's might occur if the casing strings are breached due to corrosion or mechanical failure or if there is a failure of the cement to seal the casing/borehole annulus between the casing shoe and the lowermost USDW. The testing and monitoring program described below is designed to detect and diagnose a loss of mechanical integrity in the casing or cement.

Remedial actions required to restore mechanical integrity are also described.

1.3 Scope

This TMP covers all injection wells on the 500-acre PGV site.

2. TESTING DURING DRILLING AND COMPLETION

2.1 Pressure Testing During Drilling

Each injection well is completed with three casing strings (not including the 30-inch conductor pipe) cemented to the surface (Figure 1). Upon completion of cementing each casing string and prior to drilling out the cement shoe, the casing well be pressure tested. The DLNR will be notified at least 24 hours before each test for the opportunity to witness it. The test will consist of pressurizing the casing with water or drilling mud to a specified test pressure and monitoring the pressure for 30 minutes with the well shut-in. The minimum casing test pressure shall be approximately one-third of the internal yield pressure rating, provided that the test pressure shall not be less than 600 psig nor greater than 2500 psig. In cases where combination strings or liners are involved, the above test pressures shall apply to the lowest pressure-rated casing. The pressure drop during the 30-minute period shall not exceed 10% of the test pressure.

In the event of a pressure loss exceeding the above criterion, one or more of the following diagnostic methods will be used to locate the leak:

- Temperature log while injecting
- Shut-in temperature survey
- Casing inspection logs with multi-arm caliper and/or magnetic inspection tools
- Pressure testing with a packer(s) on drillpipe
- Other applicable methods

After identification of the point of leakage, a cement squeeze job will be performed and the casing retested.

After a successful pressure test of each casing string, drilling will proceed to a point at least one foot below the casing shoe, and a pressure leak-off test will be performed to test the integrity of the annular cement. Each test will be performed at a pressure approaching the fracturing pressure of the exposed formation. If there is excessive leak-off, a squeeze cement job will be performed, the cement will be drilled out and the test will be repeated. Drilling will not proceed until an effective cement seal is established in the casing/borehole annulus above the casing shoe. In some situations, such as the case where there is natural formation permeability immediately below the casing shoe, it may not be practical to prove cement integrity with the pressure test described above. As an alternative, a standard water shutoff test (WSO) may be done above the shoe, or shut-in temperature surveys may be run.

2.2 Logs and Surveys During Injection Testing

Upon completion of drilling and prior to installation of the hangdown liner, a water injection test may be performed, if needed, to obtain a preliminary evaluation of the well. During such a test, one or more of the following logs or surveys may be run:

- TPS or T/P logs through the open hole and cased intervals with the well on injection; or

- Shut-in temperature survey(s) before and/or after injection.

If any of these logs or surveys indicates a loss of mechanical integrity, the problem will be diagnosed, and repair procedures will be performed in accordance with Section 2.3.

2.3 Casing Repair

Once a loss of mechanical integrity is identified and approximately located, casing repair procedures will be initiated. These procedures may include any or all of the following activities:

2.3.1 Shut in well and run magnetic and multi-arm casing inspection logging tools to locate the leak and to evaluate the casing condition.

2.3.2 Rig up workover rig on well. Run packer(s) on drillpipe and pressure test to confirm suspected leaking interval.

2.3.3 Execute cement squeeze job to seal casing leak or stop interzonal flows behind casing.

2.3.4 Perform casing pressure test and other diagnostic tests as necessary to confirm success of the remedial work. If good, move rig off well and return well to injection service.

2.3.5 In the event of major casing failure, a cemented liner may be installed through the damaged interval.

2.3.6 Prior to drilling out the liner shoe, the liner will be pressure tested as described in Section 2.1.

2.3.7 If mechanical integrity cannot be restored satisfactorily, the well will be plugged and abandoned.

3. MONITORING AND TESTING AFTER WELL IS PLACED IN SERVICE

3.1 Continuous Monitoring During Routine Injection Operations

During routine injection well operations, including brief periods when well(s) may be temporarily out of service, the following conditions will be maintained:

3.1.1 A continuous recording of the following parameters will be maintained for each well:

* Injection wellhead pressure,
* Annulus (nitrogen) pressure, and
* Injection flow rate.

These parameters shall be recorded on a graphical chart which shows their relationship to elapsed time. Plant operators will take daily readings at each well.

3.1.2 The annular space between the hangdown liner and cemented casing will be pressurized with nitrogen, and the pressure will be monitored and recorded in accordance with Section 3..1. above. The annulus will be repressurized with nitrogen as necessary to maintain the nitrogen/water interface at a depth of 2000 ft KB (1975 ft below ground level) or deeper. some loss of nitrogen pressure is normal, and occasional repressurization will be required. If the rate of nitrogen pressure decline is such that it is impractical to maintain the required minimum pressure, it will be considered indicative of a leak requiring diagnosis and repair.

3.2 Annual Testing

Once annually, tests and surveys will be conducted to verify mechanical integrity of the hangdown liner. The casing and hangdown liner will be tested for leaks by one of the following procedures, or a combination thereof.

3.2.1 Perform a pump-down test on the annulus between the hangdown liner and the cemented casing. The test will be done with the well on injection at normal operating flow rate and wellhead pressure, or higher.

or

3.2.2 If the hangdown liner is pulled, the casing may be pressure tested above a bridge plug or packer set near the shoe following the basic procedure outlined in Section 2.1. Integrity of the hangdown liner may be verified by inspection on the surface, by a pressure test (with nitrogen) after it is run in the hole, or by a TPS log with the well on injection.

Integrity of the cement (external mechanical integrity) will be checked during each workover by one or more of the following procedures:

3.2.3 One or more shut-in static temperature surveys will be run. Shut-in time will be at least 12 hours, or longer if necessary to obtain meaningful results.

or

3.2.4 Other logs or surveys may be run, at the discretion of PGV, if static temperature surveys are not definitive.

3.3 Restoration of Mechanical Integrity or Abandonment

In the event that the diagnostic procedures indicate a loss of mechanical integrity, remedial or abandonment procedures will be carried out as specified in Section 2.3.

MONITORING AND REPORTING SCHEDULE

UIC PERMIT NO. :

UH-1529

PERMIT ISSUED:

10/20/01

PERMIT EXPIRES:

08/24/05

[\] SCHEDULED

[X] COMPLETED

MONTH	TYPE I	TYPE III	TYPE IV	REPORT OF ANALYTICAL RESULTS ★	STATUS REPORT	MONTH	TYPE I	TYPE III	TYPE IV	REPORT OF ANALYTICAL RESULTS ★	STATUS REPORT
10/01						10/04					
11/01	\			\		11/04	\			\	
12/01					\	12/04					\
01/02	\	\	\	\		01/05	\	\	\	\	
02/02						02/05					
03/02	\			\	\	03/05	\			\	\
04/02						04/05					
05/02	\			\		05/05	\			\	
06/02					\	06/05					\
07/02	\	\	\	\		07/05	\	\	\	\	
08/02						08/05					
09/02	\			\	\						
10/02											
11/02	\			\							
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05/04	\			\							
06/04					\						
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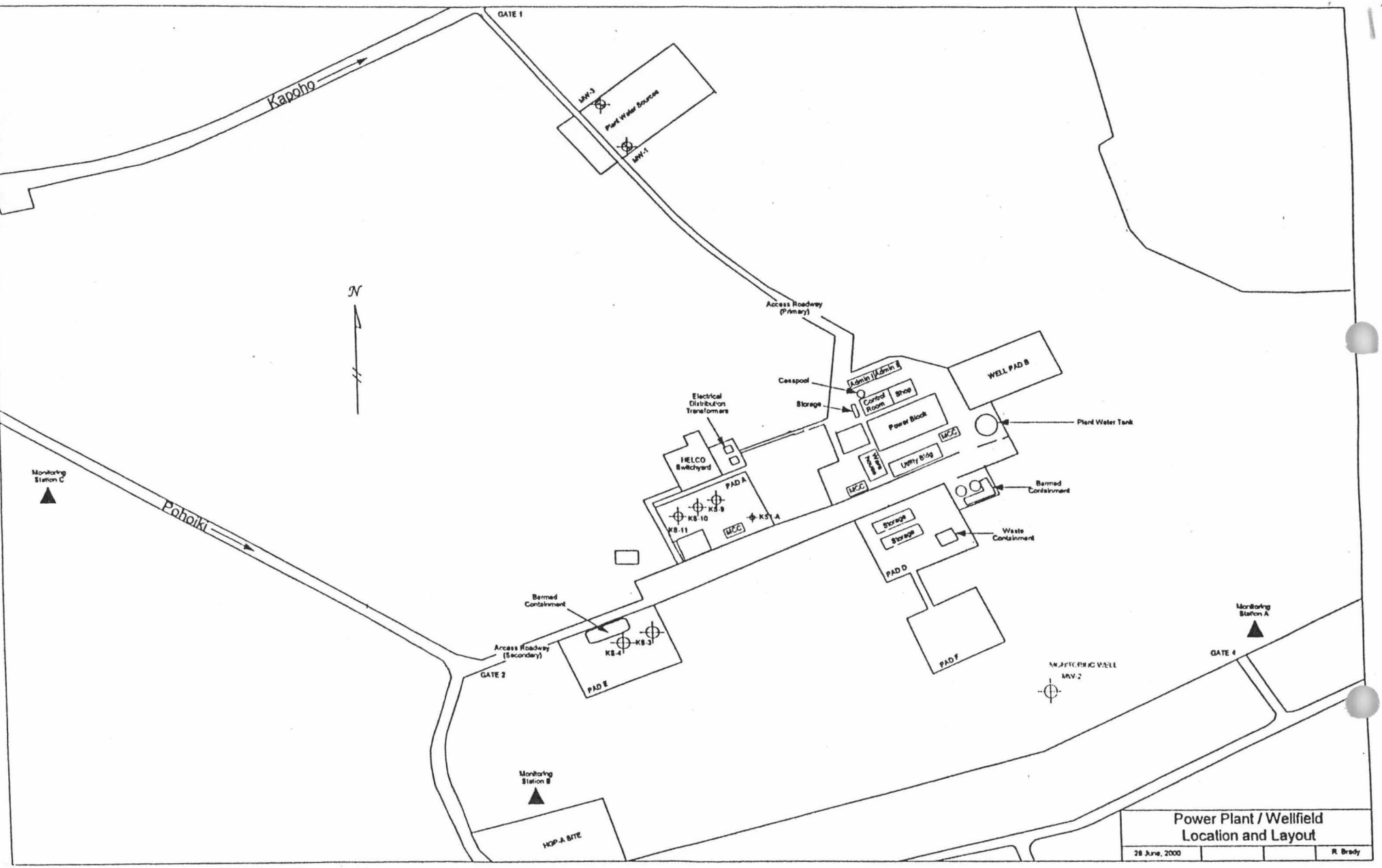
08/04											
09/04	\			\	\						

★ Submit original laboratory report with chain of custody form for the scheduled month's analyses within 60 days after the end of the designated monitoring period.



INJECTION WELL LOCATION PLAN

PUNA GEOTHERMAL VENTURE

14-3860 Kapoho Pahoa Road, Pahoa, Hawai'i

UIC Permit No. UH-1529

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

August 9, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Change in Re-Injection Line Size for KS-10 Test

Attached is a letter sent to Department of Health, Safe Drinking Water Branch regarding the change in line size for the injection test line to KS-10. There is also clarification for the control system attached to the existing line and also additional controls on the production lines to KS-10.

If there are any questions to any of the above and attached, please feel free to call on me at any time.

Mahalo,

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA GEOTHERMAL VENTURE
HAWAII

August 7, 2001

Mr. Chauncey Hew, Safe Drinking Water Branch
Hawaii Department of Health
P.O. Box 3378
Honolulu, HI 96801

Subject: **REVISED INJECTION TESTING FOR KS-10 PRODUCTION WELL**

Dear Mr. Hew:

As a follow up to our recent conversation on July 31, 2001, it is Puna Geothermal Venture's (PGV) understanding that increasing the 4" injection test line to 8" is acceptable to your department. The purpose of increasing the line size is to reduce the fluid flow velocity through the test line.

Subsequently, PGV plans to continue utilizing the existing PSH (pressure switch high) instruments to protect the existing three injection wells from exceeding 500 psig. The piping run to KS-10 is connected to a common header located at the PSH, thus the KS-10 piping pressure will also be protected by the PSH. Also, connected to the injection piping are three PSV's (pressure safety valves), located upstream of the existing injection wells which additionally protect the KS-10 piping.

Should there be any questions, or further clarification needed, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Barry T. Mizuno
Owner's Representative

Kenny Stein – Constellation
Neil Nelson – COSI
Shannon FitzGerald – EPA
Eric Tanaka – DLNR
Mike Kaleikini – PGV
Darren Hunt – PGV

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BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

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JANET E. KAWELO

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STATE PARKS
WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

May 30, 2001

'01 JUN 05 AM 05:20 WATER & LAND

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Approval Request Letters from PGV to DOH and EPA

Attached are the two letters for request from Puna Geothermal Ventures to The Department of Health and The Environmental Protection Agency in regards to the pending Tracer Testing of KS-10.

If there are any questions to any of the above, please feel free to call on me at any time.

Mahalo,

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

May 28, 2001

Mr. Chauncey Hew
Safe Drinking Water Branch
State Department of Health
P. O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Hew:

Puna Geothermal Venture ("PGV") is requesting permission to inject a tracer into its KS-10 production well. The purpose of such tracer injection is to provide test data of PGV's geothermal resource (i.e., reservoir).

The tracer injection will be conducted under the supervision of Thermochem. Thermochem's suggested procedure (including estimated quantities) is enclosed, along with a copy of the MSDS sheets for the tracer. The tracers chemical is as follows:

2--Naphthalenedisulfonic Acid Sodium Salt 100%
CAS # 532-02-5

PGV will keep records of such tracer injections, including quantities, and will record such injections in the monthly and quarterly reports. Your earliest approval is appreciated.

Should there be any questions, please do not hesitate to call.

Sincerely,

Barry T. Mizuno
Owner's Representative

Enclosures: Thermochem's ***Reservoir Tracer Injection Procedure for Puna Project***
MSDS for ***1,5-Naphthalenedisulfonic Acid Disodium Salt, Dihydrate, 100%***

cc : Eric Tanaka/Mike Kaleikini/Darren Hunt/PGV File

t:\btm\corres.out\doh\010528.wpd

THERMOCHEM

Laboratory and Consulting Services
3414 Regional Parkway, Suite A
Santa Rosa, CA 95403
(707) 575-1310 Fax (707) 575-7932

May 24, 2001

Reservoir Tracer Injection Procedure
KS-10 Tracer Test

A liquid-phase chemical tracer will be injected into KS-10 with plant injectate. The tracer will be pumped into the KS-10 injection line while the total plant injectate flow is approximately 300 gpm. The liquid phase tracer is intended to follow the brine phase in the reservoir (residual liquid injectate), and will be used to detect breakthrough of cool injectate to the production wells KS-9 and KS-11. The chemical tracer will be naphthalene sulfonic acid, sodium salt (NSA), a compound of the same class as pyrene tetrasulfonic acid, sodium salt (PTSA), the tracer previously injected into KS-4 in late 1998 for the same purpose.

The liquid tracer will be injected directly into the injection pipeline of KS-10 using the high-pressure pumps available at the site, so there will no interruption of normal operation at the plant. The tracer is shipped as a dry salt, and will be mixed on-site as a 15% by weight solution using fresh water prior to injection.

Liquid Phase Tracer

Quantity of naphthalene sulfonic acid (NSA)	100 kg, dry weight basis.
Mixing Procedure and Concentration	The compound is delivered as a dry salt in (4) 55 lbs. bags. It will be mixed and dissolved in approximately 150 gal. of fresh water to a final concentration of about 15% by weight.
Injection Procedure	Inject the 15% solution at 50 gpm into the KS-10 injection line. Total injection time should be about 3 minutes.

MATERIAL SAFETY DATA SHEET

EM SCIENCE

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer.....:
EM SCIENCE
A Division of EM Industries
P.O. Box 70
480 Democrat Road
Gibbstown, N.J. 08027

Preparation Date.: 10/30/91

Information Phone Number.: 856-423-6300
Hours: Mon. to Fri. 8:30-5
Chemtrec Emergency Number: 800-424-9300
Hours: 24 hrs a day

Catalog Number(s):

NX0069

Product Name:
2-Naphthalenesulfonic Acid Sodium Salt
Synonyms:
Sodium-2-naphthalenesulfonate
Chemical Family:
Organic Salt
Formula:
$C_{10}H_7NaO_3S$
Molecular Weight.:
230.22

2. COMPOSITION / INFORMATION ON INGREDIENTS

Component	CAS #	Appr %
2-Naphthalenesulfonic Acid Sodium Salt	532-02-5	100%

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
Slightly Irritating To Eyes And Skin.

Appearance:
Beige powder

POTENTIAL HEALTH EFFECTS (ACUTE AND CHRONIC)

Symptoms of Exposure:
Data on the toxicity of this preparation is not available. Slightly Irritating To Eyes And Skin. Handling care generally in keeping with safe laboratory practices is recommended.

Medical Cond. Aggravated by Exposure:
None indicated

Routes of Entry:
Ingestion, Inhalation

Carcinogenicity:
The material is not listed (IARC, NTP, OSHA) as cancer causing agent.

4. FIRST AID MEASURES

Emergency First Aid:

GET MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE.
Skin: Wash thoroughly with soap and water.
Eyes: Immediately flush thoroughly with water for at least 15 minutes.
Inhalation: Remove to fresh air; give artificial respiration if breathing has stopped.
Ingestion: If conscious, drink water and induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person.

5. FIRE FIGHTING MEASURES

Flash Point (F): None
Flammable Limits LEL (%): N/A
Flammable Limits UEL (%): N/A
Extinguishing Media:
Use any suitable for adjacent material.

Fire Fighting Procedures:
Wear self-contained breathing apparatus.

Fire & Explosion Hazards:
None indicated

6. ACCIDENTAL RELEASE MEASURES

Spill Response:
Evacuate the area of all unnecessary personnel. Wear suitable protective equipment listed under Exposure / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Take up and containerize for proper disposal as described under Disposal. Comply with Federal, State, and local regulations on reporting releases. Refer to Regulatory Information for

reportable quantity and other regulatory data.

7. HANDLING AND STORAGE

Handling & Storage:
Keep container closed. Do not breathe dust. Do not get in eyes. Avoid prolonged, or repeated, skin contact.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT:
Ventilation, Respiratory Protection, Protective Clothing, Eye Protection:
Material should be handled or transferred in an approved fume hood or with adequate ventilation. Protective gloves should be worn to prevent skin contact (Neoprene or equivalent) Safety glasses with side shields should be worn at all times.

Work/Hygenic Practices:
Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

EXPOSURE GUIDELINES

OSHA - PEL:

	TWA		STEL		CL		
Component	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	Skin
2-Naphthalenesulfonic Acid Sodium Salt							

ACGIH - TLV:

	TWA		STEL		CL		
Component	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	Skin
2-Naphthalenesulfonic Acid Sodium Salt							

If there are no exposure limit numbers listed in the Exposure Guidelines chart, this indicates that no OSHA or ACGIH exposure limts have been established.

9. PHYSICAL AND CHEMCIAL PROPERTIES

Boiling Point (C 760 mmHg) : N/A
Melting Point (C) : N/A
Specific Gravity (H_20 = 1) : N/A
Vapor Pressure (mm Hg) : N/A
Percent Volatile by vol (%): N/A
Vapor Density (Air = 1) : N/A
Evaporation Rate (BuAc = 1): N/A
Solubility in Water (%) : Soluble
Appearance :

Beige powder

10. STABILITY AND REACTIVITY

Stability: Yes

Hazardous Polymerization:
Does not occur

Hazardous Decomposition:
None indicated

Conditions to Avoid:
None indicated

Materials To Avoid:

( ) Water
( ) Acids
( ) Bases
( ) Corrosives
( ) Oxidizers
(X) Other: none indicated

11. TOXICOLOGICAL INFORMATION

Toxicity Data

None established

Toxicological Findings:
None
Cited in Registry of Toxic Effects of Chemical Substances (RTECS)

12. DISPOSAL CONSIDERATIONS

EPA Waste Numbers:

Treatment:
Material does not have an EPA Waste number and is not a listed waste, however consultation with a permitted waste disposal site (TSD) should be accomplished.
ALWAYS CONTACT A PERMITTED WASTE DISPOSER (TSD) TO ASSURE COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

13. TRANSPORT INFORMATION

DOT Proper Shipping Name:
non-regulated

DOT ID Number :
none

14. REGULATORY INFORMATION

TSCA Statement:
The CAS number of this product is listed on the TSCA Inventory.

Component	SARA EHS (302)	SARA EHS TPQ (lbs)	CERCLA RQ (lbs)
2-Naphthalenesulfonic Acid Sodium Salt			

Component	OSHA Floor List	SARA 313	DeMinimis for SARA 313 (%)
2-Naphthalenesulfonic Acid Sodium Salt			

If there is no information listed on the regulatory information chart, this indicates that the chemical is not covered by the specific regulation listed.

15. OTHER INFORMATION

Comments:
None

NFPA Hazard Ratings:

```
Health          : 0
Flammability    : 0
Reactivity      : 0
Special Hazards :
```

Revision History: 10/30/91

| = Revised Section

N/A = Not Available

N/E = None Establised

The statements contained herein are offered for informational purposes only and are based upon technical data that EM Science believes to be accurate. It is intended for use only by persons having the necessary technical skill and at their own discretion and risk. Since conditions and manner of use are outside our control, we make NO WARRANTY, EXPRESS OR IMPLIED, OR MERCHANTABILITY, FITNESS OR OTHERWISE.

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

May 28, 2001

Ms. Shannon FitzGerald
U.S Environmental Protection Agency, Region IX
Ground Water Office WTR-9
75 Hawthorne Street
San Francisco, Calif. 94105

Dear Ms. FitzGerald:

Pursuant to Permit No. HI596002 Underground Injection Control Permit Part II Section D.4.d.e, Puna Geothermal Venture ("PGV") is requesting permission to inject a tracer into its KS-10 production well. The purpose of such tracer injection is to provide test data of PGV's geothermal resource (i.e., reservoir).

The tracer injection will be conducted under the supervision of Thermochem. Thermochem's suggested procedure (including estimated quantities) is enclosed, along with a copy of the MSDS sheets for the tracer. The tracers chemical is as follows:

2--Naphthalenedisulfonic Acid Sodium Salt 100%
CAS # 532-02-5

PGV will keep records of such tracer injections, including quantities, and will record such injections in the monthly and quarterly reports. Your earliest approval is appreciated.

Should there be any questions, please do not hesitate to call.

Sincerely,

Barry T. Mizuno
Owner's Representative

Enclosures: Thermochem's ***Reservoir Tracer Injection Procedure for Puna Project***
MSDS for ***1,5-Naphthalenedisulfonic Acid Disodium Salt, Dihydrate, 100%***

cc : Eric Tanaka/Mike Kaleikini/Darren Hunt/PGV File

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THERMOCHEM

Laboratory and Consulting Services
3414 Regional Parkway, Suite A
Santa Rosa, CA 95403
(707) 575-1310 Fax (707) 575-7932

May 24, 2001

Reservoir Tracer Injection Procedure
KS-10 Tracer Test

A liquid-phase chemical tracer will be injected into KS-10 with plant injectate. The tracer will be pumped into the KS-10 injection line while the total plant injectate flow is approximately 300 gpm. The liquid phase tracer is intended to follow the brine phase in the reservoir (residual liquid injectate), and will be used to detect breakthrough of cool injectate to the production wells KS-9 and KS-11. The chemical tracer will be naphthalene sulfonic acid, sodium salt (NSA), a compound of the same class as pyrene tetrasulfonic acid, sodium salt (PTSA), the tracer previously injected into KS-4 in late 1998 for the same purpose.

The liquid tracer will be injected directly into the injection pipeline of KS-10 using the high-pressure pumps available at the site, so there will no interruption of normal operation at the plant. The tracer is shipped as a dry salt, and will be mixed on-site as a 15% by weight solution using fresh water prior to injection.

Liquid Phase Tracer

Quantity of naphthalene sulfonic acid (NSA)	100 kg, dry weight basis.
Mixing Procedure and Concentration	The compound is delivered as a dry salt in (4) 55 lbs. bags. It will be mixed and dissolved in approximately 150 gal. of fresh water to a final concentration of about 15% by weight.
Injection Procedure	Inject the 15% solution at 50 gpm into the KS-10 injection line. Total injection time should be about 3 minutes.

MATERIAL SAFETY DATA SHEET

EM SCIENCE

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer.....:
EM SCIENCE
A Division of EM Industries
P.O. Box 70
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Preparation Date.: 10/30/91

Information Phone Number.: 856-423-6300
Hours: Mon. to Fri. 8:30-5
Chemtrec Emergency Number: 800-424-9300
Hours: 24 hrs a day

Catalog Number(s):

NX0069

Product Name:
2-Naphthalenesulfonic Acid Sodium Salt
Synonyms:
Sodium-2-naphthalenesulfonate
Chemical Family:
Organic Salt
Formula:
$C_{10}H_7NaO_3S$
Molecular Weight.:
230.22

2. COMPOSITION / INFORMATION ON INGREDIENTS

Component	CAS #	Appr %
2-Naphthalenesulfonic Acid Sodium Salt	532-02-5	100%

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
Slightly Irritating To Eyes And Skin.

Appearance:
Beige powder

POTENTIAL HEALTH EFFECTS (ACUTE AND CHRONIC)

Symptoms of Exposure:
Data on the toxicity of this preparation is not available. Slightly Irritating To Eyes And Skin. Handling care generally in keeping with safe laboratory practices is recommended.

Medical Cond. Aggravated by Exposure:
None indicated

Routes of Entry:
Ingestion, Inhalation

Carcinogenicity:
The material is not listed (IARC, NTP, OSHA) as cancer causing agent.

4. FIRST AID MEASURES

Emergency First Aid:

GET MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE.
Skin: Wash thoroughly with soap and water.
Eyes: Immediately flush thoroughly with water for at least 15 minutes.
Inhalation: Remove to fresh air; give artificial respiration if breathing has stopped.
Ingestion: If conscious, drink water and induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person.

5. FIRE FIGHTING MEASURES

Flash Point (F): None
Flammable Limits LEL (%): N/A
Flammable Limits UEL (%): N/A
Extinguishing Media:
Use any suitable for adjacent material.

Fire Fighting Procedures:
Wear self-contained breathing apparatus.

Fire & Explosion Hazards:
None indicated

6. ACCIDENTAL RELEASE MEASURES

Spill Response:
Evacuate the area of all unnecessary personnel. Wear suitable protective equipment listed under Exposure / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Take up and containerize for proper disposal as described under Disposal. Comply with Federal, State, and local regulations on reporting releases. Refer to Regulatory Information for

reportable quantity and other regulato[illegible]ata.

7. HANDLING AND STORAGE

Handling & Storage:
Keep container closed. Do not breathe dust. Do not get in eyes. Avoid prolonged, or repeated, skin contact.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT:
Ventilation, Respiratory Protection, Protective Clothing, Eye Protection:
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Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

EXPOSURE GUIDELINES

OSHA - PEL:

	TWA		STEL		CL		
Component	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	Skin
2-Naphthalenesulfonic Acid Sodium Salt							

ACGIH - TLV:

	TWA		STEL		CL		
Component	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	Skin
2-Naphthalenesulfonic Acid Sodium Salt							

If there are no exposure limit numbers listed in the Exposure Guidelines chart, this indicates that no OSHA or ACGIH exposure limts have been established.

9. PHYSICAL AND CHEMCIAL PROPERTIES

Boiling Point (C 760 mmHg) : N/A
Melting Point (C) : N/A
Specific Gravity (H_20 = 1) : N/A
Vapor Pressure (mm Hg) : N/A
Percent Volatile by vol (%): N/A
Vapor Density (Air = 1) : N/A
Evaporation Rate (BuAc = 1): N/A
Solubility in Water (%) : Soluble
Appearance :

Beige powder

10. STABILITY AND REACTIVITY

Stability: Yes

Hazardous Polymerization:
Does not occur

Hazardous Decomposition:
None indicated

Conditions to Avoid:
None indicated

Materials To Avoid:

( ) Water
( ) Acids
( ) Bases
( ) Corrosives
( ) Oxidizers
(X) Other: none indicated

11. TOXICOLOGICAL INFORMATION

Toxicity Data

None established

Toxicological Findings:
None
Cited in Registry of Toxic Effects of Chemical Substances (RTECS)

12. DISPOSAL CONSIDERATIONS

EPA Waste Numbers:

Treatment:
Material does not have an EPA Waste number and is not a listed waste, however consultation with a permitted waste disposal site (TSD) should be accomplished.
ALWAYS CONTACT A PERMITTED WASTE DISPOSER (TSD) TO ASSURE COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

13. TRANSPORT INFORMATION

DOT Proper Shipping Name:
non-regulated

DOT ID Number :
none

14. REGULATORY INFORMATION

TSCA Statement:
The CAS number of this product is listed on the TSCA Inventory.

Component	SARA EHS (302)	SARA EHS TPQ (lbs)	CERCLA RQ (lbs)
2-Naphthalenesulfonic Acid Sodium Salt			

Component	OSHA Floor List	SARA 313	DeMinimis for SARA 313 (%)
2-Naphthalenesulfonic Acid Sodium Salt			

If there is no information listed on the regulatory information chart, this indicates that the chemical is not covered by the specific regulation listed.

15. OTHER INFORMATION

Comments:
None

NFPA Hazard Ratings:

```
Health          : 0
Flammability    : 0
Reactivity      : 0
Special Hazards :
```

Revision History: 10/30/91

| = Revised Section

N/A = Not Available

N/E = None Establised

The statements contained herein are offered for informational purposes only and are based upon technical data that EM Science believes to be accurate. It is intended for use only by persons having the necessary technical skill and at their own discretion and risk. Since conditions and manner of use are outside our control, we make NO WARRANTY, EXPRESS OR IMPLIED, OR MERCHANTABILITY, FITNESS OR OTHERWISE.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
JANET E. KAWELO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
ENGINEERING BRANCH
PLANNING BRANCH
TECHNICAL & SUPPORT BRANCH
STATE PARKS
WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

May 10, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Copies of Approval Request to EPA and DOH for the injection testing of KS-10

Attached are copies of the approval request letters for the injection testing of KS-10 from Puna Geothermal Ventures to The Department of Health, UIC Program, and EPA, Ground Water Protection Office.

Note: A request for approval for the modification of KS-10 to the DLNR will be forth coming.

If there are any questions to any of the above, please feel free to call on me at any time.

Mahalo,

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

May 9, 2001
Mr. Chauncey Hew, Clean Water Branch
Hawaii Department of Health
P.O. Box 3378
Honolulu, HI 96801

Subject: Injection testing at well KS-10.

Dear Mr. Hew:

As a follow up to our recent phone conversation on May 8, 2001, Puna Geothermal Venture (PGV) is requesting approval, and would like to provide information, outlining a proposal to perform an injection test at production well KS-10. Should this test be approved, PGV would be able to conduct a thorough evaluation on the viability of converting production well KS-10 into an injection well.

Well KS-10 has been out of production service as of late January 2001. The deliverability of the well has reached a point whereby it became operationally prudent to take KS-10 out of service. For safety considerations, a nitrogen "blanket" has been maintained on the wellhead.

In order to prove mechanical integrity of the 9 5/8" casing, the following attachments have been enclosed for review:

A. Pressure/Temperature (P/T) survey data from 1 February 2001.
B. Copy of Barton Chart recorder (KS-10 Wellhead pressure test).
C. Spreadsheet titled *KS-10 Shut-In grad.*
D. Process flow diagram titled *Proposed KS-10 Injection Test.*

The P/T survey, Barton chart recorder, & KS-10 Shut-In gradient data sheets indicates that the casing integrity from the surface to below 2000' KB is satisfactory. The Barton chart recorder indicates that the total pressure drop during the five-hour test was less than ~10 psig. The existing maximum pressure loss for proving mechanical integrity is 150 psig over the five-hour pressure test period. PGV's resource consultant Ross Denton generated the KS-10 Shut-In Gradient worksheet. Mr. Denton's calculated depth vs. wellhead pressure was derived using the P/T survey performed on February 1, 2001. The spreadsheet indicates that a wellhead pressure of 705 psig correlates to a fluid level of 3000'. During the five-hour pressure test, the wellhead pressure was maintained at ~700 psig, which correlates to a fluid level of ~3000' KB.

From a safety standpoint, the process flow diagram will help illustrate PGV's plan. Please note that we are proposing to utilize existing piping between the three existing injection wells, and KS-10. The existing PSH (Pressure Switch High) instrument will continue to protect the existing three injection wells from exceeding 500 psig. The piping run to KS-10 is connected to the common piping where the PSH is located, thus the KS-10 piping pressure will also be protected

by the PSH. Also, due to the common connected injection piping, the three PSV's (pressure safety valves) located upstream of the existing injection wells will also help protect the KS-10 piping. As a note, the PSH is set to shut-in all of the production wells if the injection line pressure reaches 470 psig. KS-10 wellhead pressure will also be monitored in the control room.

From a flow rate monitoring standpoint, all four FT's (flow transmitters) will be utilized. PGV will be able to derive the injection rate into KS-10 by subtracting the sum of the three injection well FT's, from the FT located downstream of the PSH and BIP (brine injection pump). In the unlikely event of reverse flow (up & out from KS-10), the existing 8" control valve will be used to shut-in the KS-10 well.

Based on existing operational conditions, the test PGV is proposing could take any where from a few days, and potentially up to a year. PGV would like to be able to determine the actual duration based on data that will be collected during the injection test. PGV intends to commence injection at a low flow rate (<100 gpm) and slowly increase the injection rate. There is a potential for PGV to increase the injection rate to >400 gpm. The test injection rates will depend quite heavily on the resultant operational conditions at production well KS-9. There is a potential for the injection fluids to adversely affect the production flow from KS-9. If adverse effects are noted during the test, PGV would take immediate steps to eliminate the adverse effects, up to and including complete termination of the test. PGV would like to commence the test as soon as approval is granted.

Should there be any questions, or if further clarification is requested, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Michael L Kaleikini
for

Barry T. Mizuno
Owner's Representative

Kenny Stein – Constellation
Neil Nelson – COSI
Shannon FitzGerald – EPA
Eric Tanaka – DLNR
Mike Kaleikini – PGV
Darren Hunt – PGV

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PRUETT INDUSTRIES, INC.
8915 ROSEDALE HWY BAKERSFIELD, CA 93312
(805) 589-2768 FAX (805) 589-3268

SUB-SURFACE PRESSURE SURVEY

CO. PUNA GEOTHERMAL	RUN 5A FIELD KAPOHO	WELL KS10
EFF DEPTH	WELL STAT STATIC	TOOL HUNG
CASING 9 5/8" 0' -4033'	CASING PRESS	ON BOTTOM
LINER 7" 3798' -4692'	TUBING PRESS	OFF BOTTOM
DATE 020101	ELEMENT RANGE 0 - 4055	ZERO POINT 25'
ELEVATION	ZONE	SHUT-IN
MAX TEMP	PICK-UP	ON-PROD
PERF 4692' -5083'	CAL SER NO. V3965	MPP
TUBING -		
UNITS ENGLISH	PURPOSE STATIC AMERADA PRESS GRADIENT	

SURVEY DATA

CO. PUNA GEOTHERMAL RUN 5A FIELD KAPOHO WELL KS10

TIME	DEPTH	P-T	GRAD	TIME	DEPTH	P-T	GRAD
1:00	50	32.3	.000	1:00	2500	520.0	.313
1:00	500	32.3	.000	1:00	3000	675.8	.311
1:00	1000	81.9	.099	1:00	3500	830.3	.309
1:00	1500	221.5	.279	1:00	4000	985.3	.310
1:00	2000	363.8	.285	1:00	4600	1170.8	.309

BY STEVE WILSON

PRUETT INDUSTRIES, INC.
8915 ROSEDALE HWY BAKERSFIELD, CA 93312
(805) 589-2768 FAX (805) 589-3268

SUB-SURFACE TEMPERATURE SURVEY

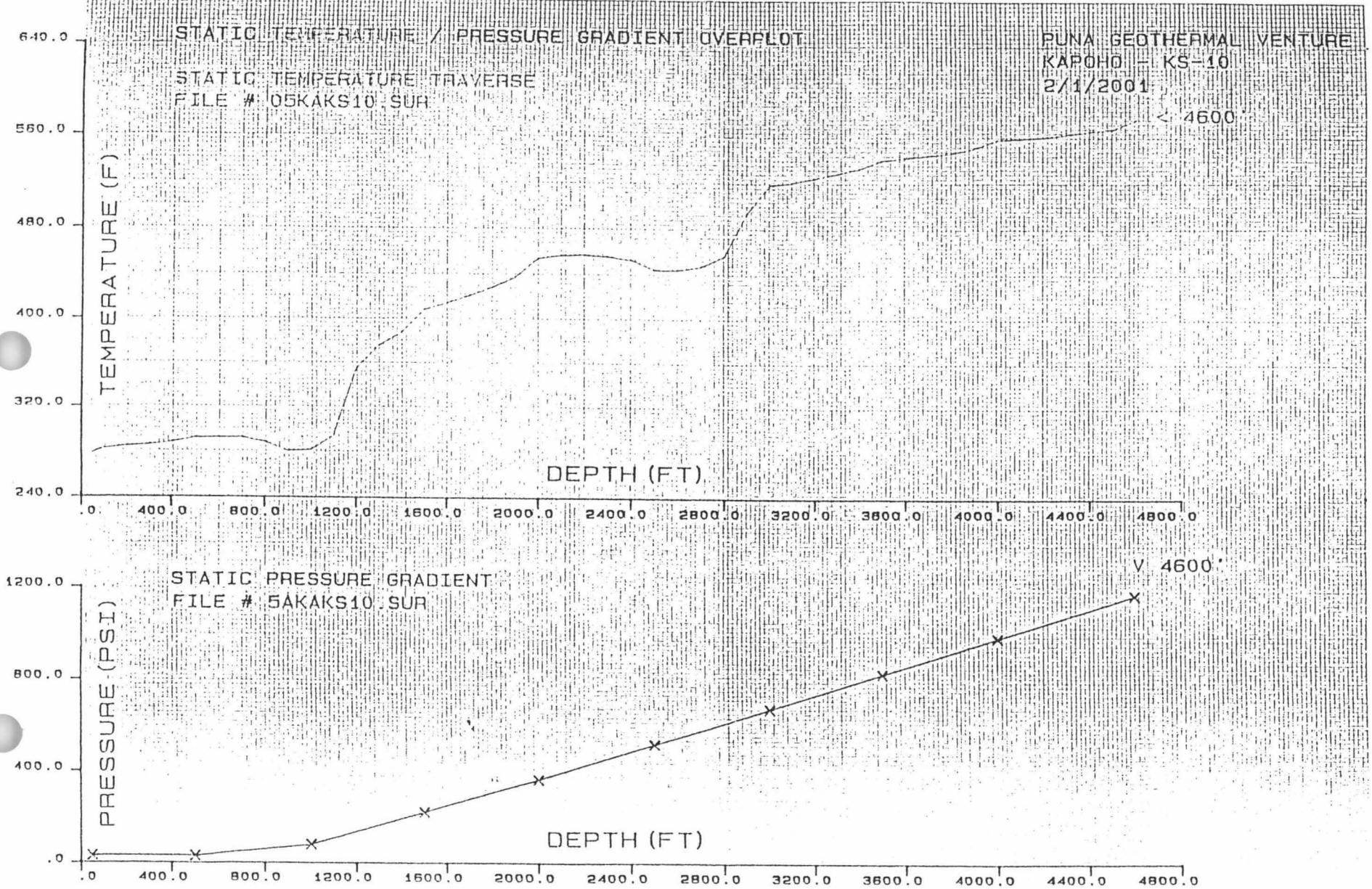
CO. PUNA GEOTHERMAL	RUN 05 FIELD KAPOHO	WELL KS10
EFF DEPTH	WELL STAT STATIC	TOOL HUNG
CASING 9 5/8"0' -4033'	CASING PRESS	ON BOTTOM 10:16
LINER 7" 3798'-4692'	TUBING PRESS	OFF BOTTOM 10:23
DATE 020101	ELEMENT RANGE 86 - 706	ZERO POINT 25'
ELEVATION	ZONE	SHUT-IN
MAX TEMP	PICK-UP	ON-PROD
PERF 4692'-5083'	CAL SER NO. 5830	MPP
TUBING -		
UNITS ENGLISH	PURPOSE STATIC TEMP TRAVERSE	

SURVEY DATA

CO. PUNA GEOTHERMAL RUN 05 FIELD KAPOHO WELL KS10

TIME	DEPTH	P-T	GRAD	TIME	DEPTH	P-T	GRAD
1:00	50	277.9	.000	1:00	2400	452.4	-.028
1:00	100	282.2	.086	1:00	2500	443.7	-.087
1:00	200	284.4	.021	1:00	2600	443.7	.000
1:00	300	285.9	.015	1:00	2700	446.5	.028
1:00	400	287.7	.018	1:00	2800	455.8	.093
1:00	500	291.7	.040	1:00	2900	494.1	.383
1:00	600	292.0	.003	1:00	3000	518.5	.243
1:00	700	292.4	.003	1:00	3100	521.0	.025
1:00	800	288.4	-.040	1:00	3200	524.4	.034
1:00	900	280.4	-.080	1:00	3300	528.5	.041
1:00	1000	281.6	.012	1:00	3400	532.8	.044
1:00	1100	293.9	.123	1:00	3500	540.0	.072
1:00	1200	354.9	.610	1:00	3600	542.2	.022
1:00	1300	375.5	.207	1:00	3700	544.4	.022
1:00	1400	387.3	.117	1:00	3800	546.6	.022
1:00	1500	408.0	.207	1:00	3900	550.3	.038
1:00	1600	414.2	.062	1:00	4000	557.5	.072
1:00	1700	420.7	.065	1:00	4100	558.5	.009
1:00	1800	428.2	.074	1:00	4200	560.0	.016
1:00	1900	437.2	.090	1:00	4300	562.5	.025
1:00	2000	453.6	.165	1:00	4400	565.3	.028
1:00	2100	456.4	.028	1:00	4500	567.2	.019
1:00	2200	457.1	.006	1:00	4600	575.3	.081
1:00	2300	455.2	-.019	0:00	0	.0	.000

BY STEVE WILSON


STATIC TEMPERATURE / PRESSURE GRADIENT OVERPLOT
STATIC TEMPERATURE TRAVERSE
FILE # 05KAKS10.SUR
PUNA GEOTHERMAL VENTURE
KAPOHO - KS-10
2/1/2001
< 4600
TEMPERATURE (F)
640.0
560.0
480.0
400.0
320.0
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DEPTH (FT)
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800.0
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2000.0
2400.0
2800.0
3200.0
3600.0
4000.0
4400.0
4800.0
STATIC PRESSURE GRADIENT
FILE # 5AKAKS10.SUR
V 4600'
PRESSURE (PSI)
1200.0
800.0
400.0
.0
DEPTH (FT)
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400.0
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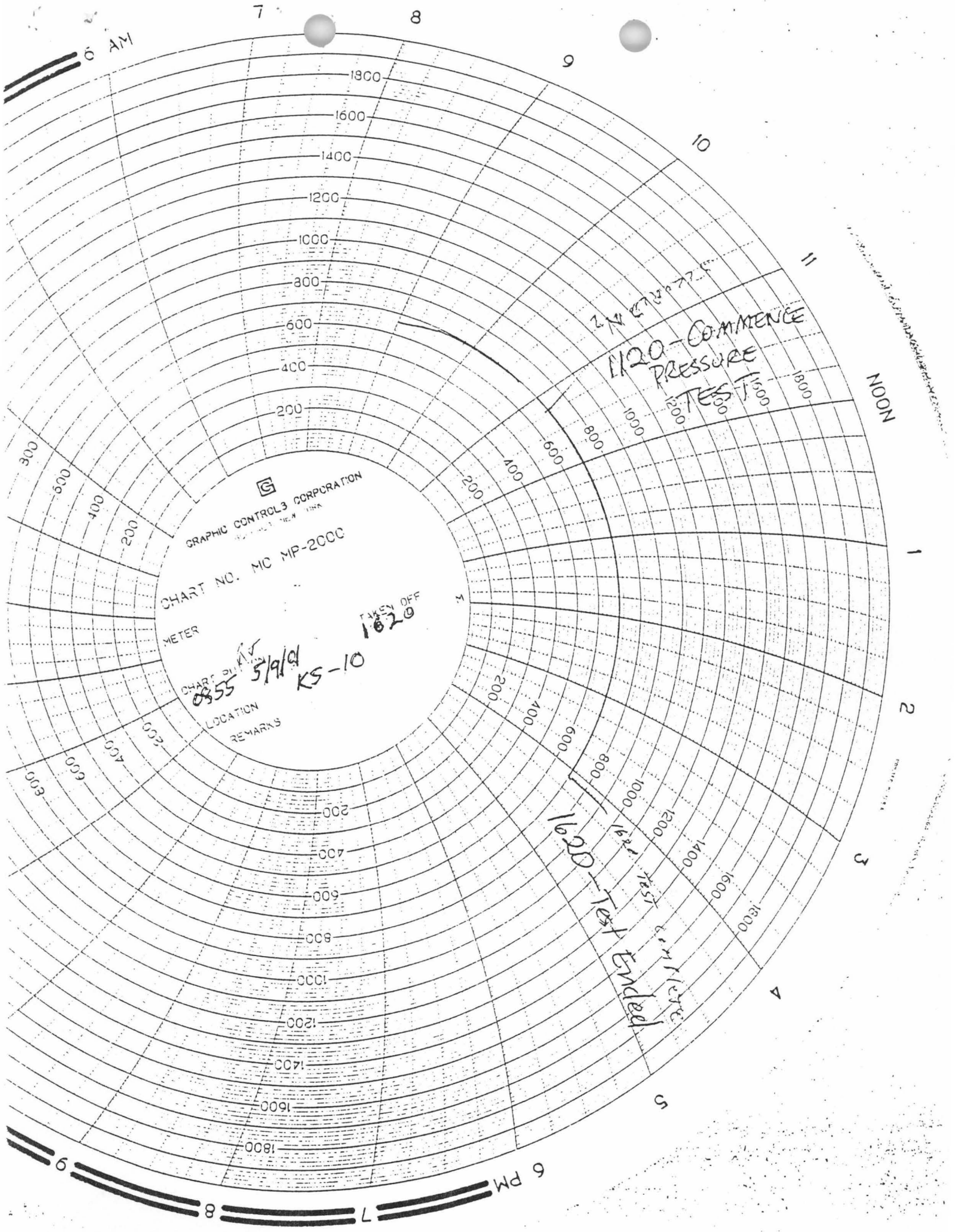
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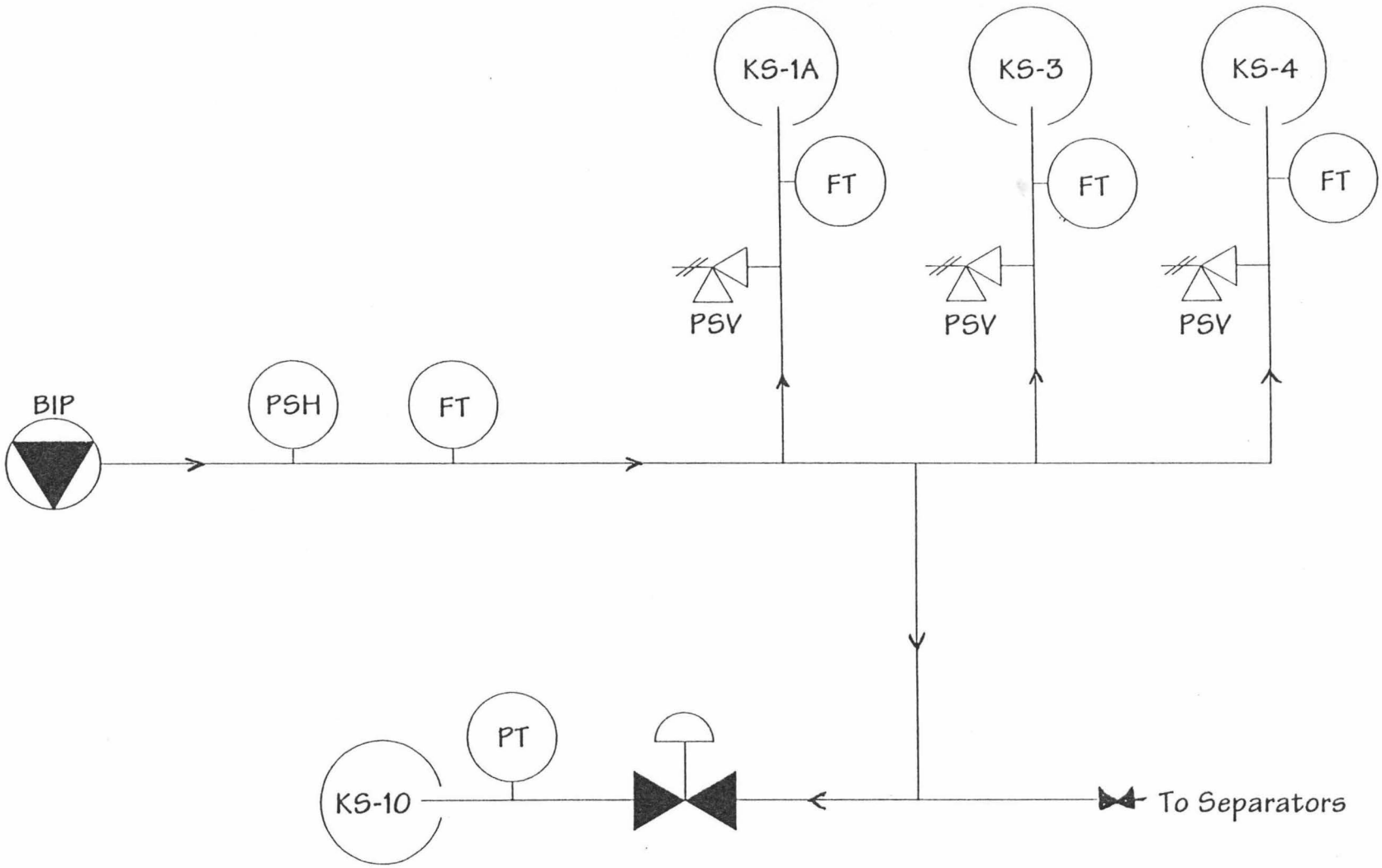
400
200
GRAPHIC CONTROLS CORPORATION
CHART NO. MC MP-2CCC
METER
TAKEN OFF
1620
5/9/91
KS-10
LOCATION
REMARKS
1120 - COMMENCE PRESSURE TEST
1620 - Test Ended
16hr test completed

KS-10 Calculation of Minimum Required Annulus Nitrogen Pressure		
Well Shut-In (Annulus Fluid Level at 800 ft KB)		
Wellbore Conditions		
Date =	2/1/01	
Shut-In Pressure (psig) from Most Recent Survey =	MD	psig
	50	33
	500	33
	800	63.6
	1000	84
	1500	225
	2000	367
	2500	537
	3000	705
	3500	856
	4000	994
	4600	1157
	4700	1194.1
KB Height Above Ground Level (ft) =	25.0	



PUNA GEOTHERMAL VENTURE
HAWAII

Proposed KS-10 Injection Test

9 May, 2001 | R. F. Brady

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

May 9, 2001
Ms. Shannon FitzGerald
U.S. Environmental Protection Agency, Region IX
Ground Water Office (WTR-9)
75 Hawthorne St.
San Francisco, CA. 94105

Subject: Injection testing at well KS-10.

Dear Ms. FitzGerald:

As a follow up to our recent phone conversation on May 8, 2001, Puna Geothermal Venture (PGV) is requesting approval, and would like to provide information, outlining a proposal to perform an injection test at production well KS-10. Should this test be approved, PGV would be able to conduct a thorough evaluation on the viability of converting production well KS-10 into an injection well.

Well KS-10 has been out of production service as of late January 2001. The deliverability of the well has reached a point whereby it became operationally prudent to take KS-10 out of service. For safety considerations, a nitrogen "blanket" has been maintained on the wellhead.

In order to prove mechanical integrity of the 9 5/8" casing, the following attachments have been enclosed for review:

A. Pressure/Temperature (P/T) survey data from 1 February 2001.
B. Copy of Barton Chart recorder (KS-10 Wellhead pressure test).
C. Spreadsheet titled *KS-10 Shut-In grad.*
D. Process flow diagram titled *Proposed KS-10 Injection Test.*

The P/T survey, Barton chart recorder, & KS-10 Shut-In gradient data sheets indicates that the casing integrity from the surface to below 2000' KB is satisfactory. The Barton chart recorder indicates that the total pressure drop during the five-hour test was less than ~10 psig. The existing maximum pressure loss for proving mechanical integrity is 150 psig over the five-hour pressure test period. PGV's resource consultant Ross Denton generated the KS-10 Shut-In Gradient worksheet. Mr. Denton's calculated depth vs. wellhead pressure was derived using the P/T survey performed on February 1, 2001. The spreadsheet indicates that a wellhead pressure of 705 psig correlates to a fluid level of 3000'. During the five-hour pressure test, the wellhead pressure was maintained at ~700 psig, which correlates to a fluid level of ~3000' KB.

From a safety standpoint, the process flow diagram will help illustrate PGV's plan. Please note that we are proposing to utilize existing piping between the three existing injection wells, and KS-10. The existing PSH (Pressure Switch High) instrument will continue to protect the existing three injection wells from exceeding 500 psig. The piping run to KS-10 is connected to the

common piping where the PSH is located, thus the KS-10 piping pressure will also be protected by the PSH. Also, due to the common connected injection piping, the three PSV's (pressure safety valves) located upstream of the existing injection wells will also help protect the KS-10 piping. As a note, the PSH is set to shut-in all of the production wells if the injection line pressure reaches 470 psig. KS-10 wellhead pressure will also be monitored in the control room.

From a flow rate monitoring standpoint, all four FT's (flow transmitters) will be utilized. PGV will be able to derive the injection rate into KS-10 by subtracting the sum of the three injection well FT's, from the FT located downstream of the PSH and BIP (brine injection pump). In the unlikely event of reverse flow (up & out from KS-10), the existing 8" control valve will be used to shut-in the KS-10 well.

Based on existing operational conditions, the test PGV is proposing could take any where from a few days, and potentially up to a year. PGV would like to be able to determine the actual duration based on data that will be collected during the injection test. PGV intends to commence injection at a low flow rate (<100 gpm) and slowly increase the injection rate. There is a potential for PGV to increase the injection rate to >400 gpm. The test injection rates will depend quite heavily on the resultant operational conditions at production well KS-9. There is a potential for the injection fluids to adversely affect the production flow from KS-9. If adverse effects are noted during the test, PGV would take immediate steps to eliminate the adverse effects, up to and including complete termination of the test. PGV would like to commence the test as soon as approval is granted.

Should there be any questions, or if further clarification is requested, please do not hesitate to call me at (808) 965-6233.

Sincerely,

Michael Kaleikini
for

Barry T. Mizuno
Owner's Representative

Kenny Stein – Constellation
Neil Nelson – COSI
Chauncey Hew – HDOH
Eric Tanaka – DLNR
Mike Kaleikini – PGV
Darren Hunt – PGV

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PRUETT INDUSTRIES, INC.
8915 ROSEDALE HWY BAKERSFIELD, CA 93312
(805) 589-2768 FAX (805) 589-3268

SUB-SURFACE PRESSURE SURVEY

CO. PUNA GEOTHERMAL	RUN 5A FIELD KAPOHO	WELL KS10
EFF DEPTH	WELL STAT STATIC	TOOL HUNG
CASING 9 5/8"0' -4033'	CASING PRESS	ON BOTTOM
LINER 7" 3798'-4692'	TUBING PRESS	OFF BOTTOM
DATE 020101	ELEMENT RANGE 0 - 4055	ZERO POINT 25'
ELEVATION	ZONE	SHUT-IN
MAX TEMP	PICK-UP	ON-PROD
PERF 4692'-5083'	CAL SER NO. V3965	MPP
TUBING -		
UNITS ENGLISH	PURPOSE STATIC AMERADA PRESS GRADIENT	

SURVEY DATA

CO. PUNA GEOTHERMAL RUN 5A FIELD KAPOHO WELL KS10

TIME	DEPTH	P-T	GRAD	TIME	DEPTH	P-T	GRAD
1:00	50	32.3	.000	1:00	2500	520.0	.313
1:00	500	32.3	.000	1:00	3000	675.8	.311
1:00	1000	81.9	.099	1:00	3500	830.3	.309
1:00	1500	221.5	.279	1:00	4000	985.3	.310
1:00	2000	363.8	.285	1:00	4600	1170.8	.309

BY STEVE WILSON

PRUETT INDUSTRIES, INC.
8915 ROSEDALE HWY BAKERSFIELD, CA 93312
(805) 589-2768 FAX (805) 589-3268

SUB-SURFACE TEMPERATURE SURVEY

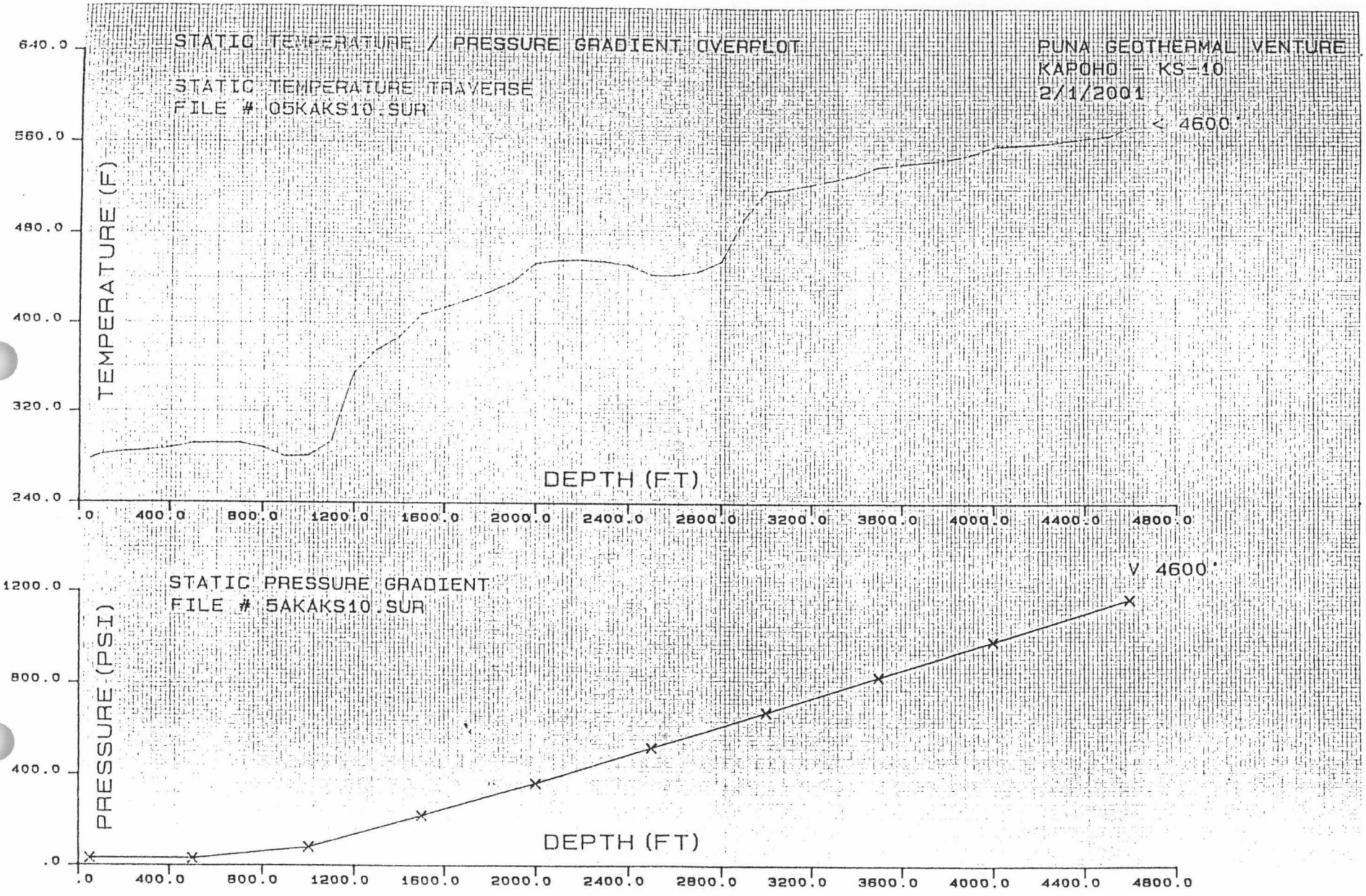
CO. PUNA GEOTHERMAL	RUN 05 FIELD KAPOHO	WELL KS10
EFF DEPTH	WELL STAT STATIC	TOOL HUNG
CASING 9 5/8"0' -4033'	CASING PRESS	ON BOTTOM 10:16
LINER 7" 3798'-4692'	TUBING PRESS	OFF BOTTOM 10:23
DATE 020101	ELEMENT RANGE 86 - 706	ZERO POINT 25'
ELEVATION	ZONE	SHUT-IN
MAX TEMP	PICK-UP	ON-PROD
PERF 4692'-5083'	CAL SER NO. 5830	MPP
TUBING -		
UNITS ENGLISH	PURPOSE STATIC TEMP TRAVERSE	

SURVEY DATA

CO. PUNA GEOTHERMAL RUN 05 FIELD KAPOHO WELL KS10

TIME	DEPTH	P-T	GRAD	TIME	DEPTH	P-T	GRAD
1:00	50	277.9	.000	1:00	2400	452.4	-.028
1:00	100	282.2	.086	1:00	2500	443.7	-.087
1:00	200	284.4	.021	1:00	2600	443.7	.000
1:00	300	285.9	.015	1:00	2700	446.5	.028
1:00	400	287.7	.018	1:00	2800	455.8	.093
1:00	500	291.7	.040	1:00	2900	494.1	.383
1:00	600	292.0	.003	1:00	3000	518.5	.243
1:00	700	292.4	.003	1:00	3100	521.0	.025
1:00	800	288.4	-.040	1:00	3200	524.4	.034
1:00	900	280.4	-.080	1:00	3300	528.5	.041
1:00	1000	281.6	.012	1:00	3400	532.8	.044
1:00	1100	293.9	.123	1:00	3500	540.0	.072
1:00	1200	354.9	.610	1:00	3600	542.2	.022
1:00	1300	375.5	.207	1:00	3700	544.4	.022
1:00	1400	387.3	.117	1:00	3800	546.6	.022
1:00	1500	408.0	.207	1:00	3900	550.3	.038
1:00	1600	414.2	.062	1:00	4000	557.5	.072
1:00	1700	420.7	.065	1:00	4100	558.5	.009
1:00	1800	428.2	.074	1:00	4200	560.0	.016
1:00	1900	437.2	.090	1:00	4300	562.5	.025
1:00	2000	453.6	.165	1:00	4400	565.3	.028
1:00	2100	456.4	.028	1:00	4500	567.2	.019
1:00	2200	457.1	.006	1:00	4600	575.3	.081
1:00	2300	455.2	-.019	0:00	0	.0	.000

BY STEVE WILSON


STATIC TEMPERATURE / PRESSURE GRADIENT OVERPLOT
PUNA GEOTHERMAL VENTURE
KAPOHO - KS-10
2/1/2001
STATIC TEMPERATURE TRAVERSE
FILE # 05KAKS10.SUR
< 4600'
TEMPERATURE (F)
640.0
560.0
480.0
400.0
320.0
240.0
DEPTH (FT)
.0
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1600.0
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2800.0
3200.0
3600.0
4000.0
4400.0
4800.0
STATIC PRESSURE GRADIENT
FILE # 5AKAKS10.SUR
V 4600'
PRESSURE (PSI)
1200.0
800.0
400.0
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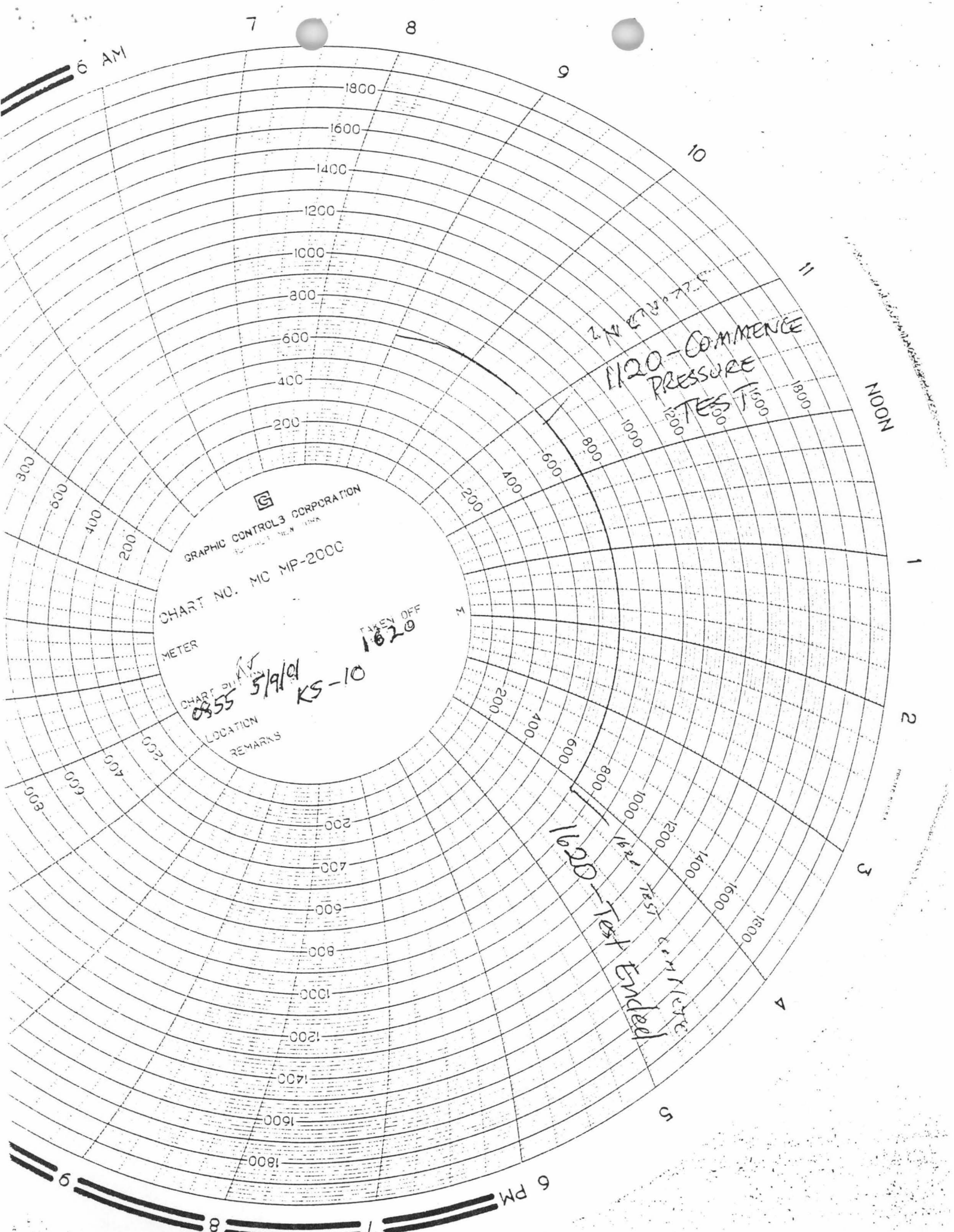
DEPTH (FT)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NOON
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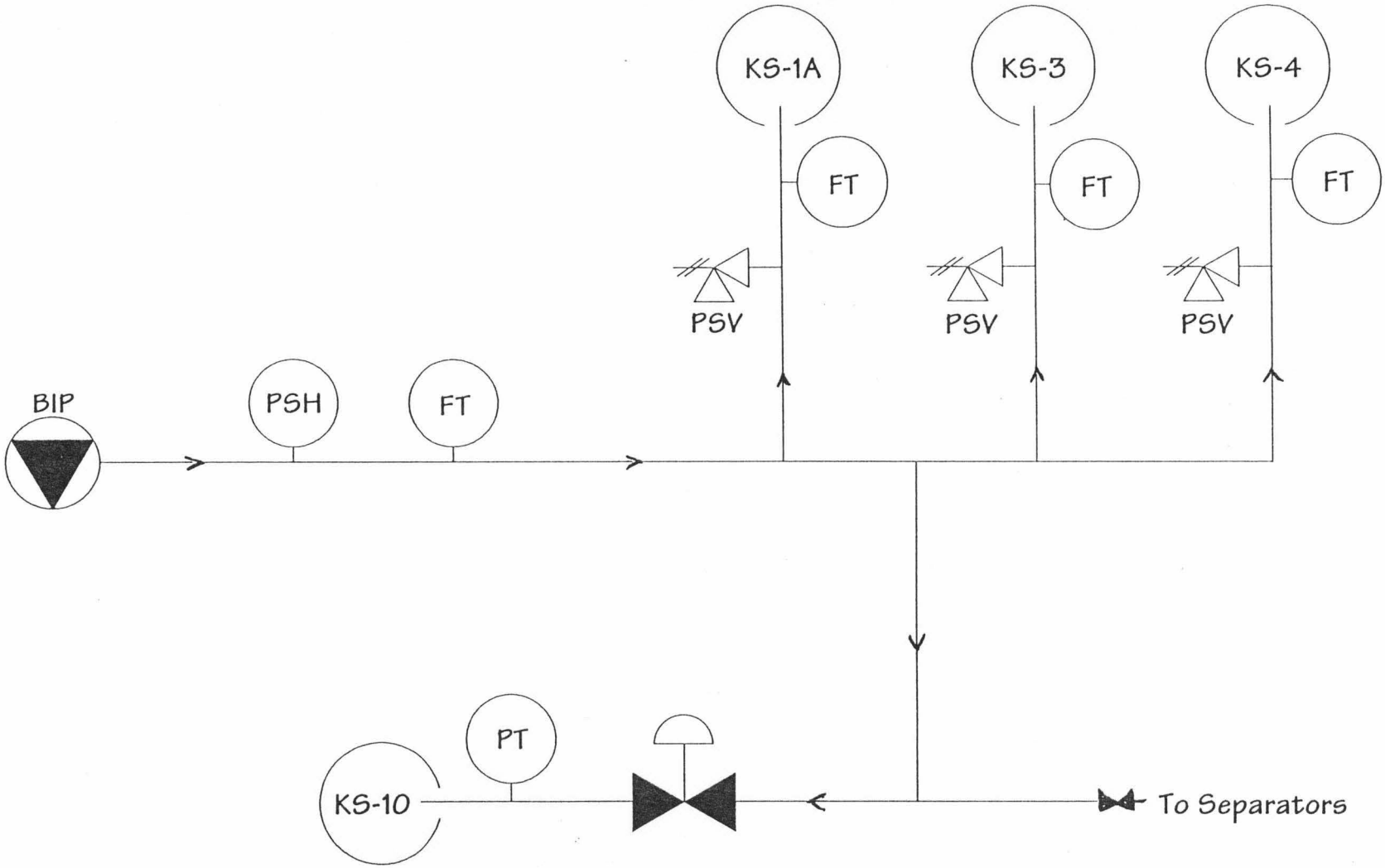
5
6 PM
GRAPHIC CONTROLS CORPORATION
CHART NO. MC MP-2000
METER
CHART PUT ON
0855 5/9/01 KS-10
TAKEN OFF
1620
LOCATION
REMARKS
1120 - COMMENCE PRESSURE TEST
1620 - Test Ended

KS-10 Calculation of Minimum Required Annulus Nitrogen Pressure		
Well Shut-In (Annulus Fluid Level at 800 ft KB)		
Wellbore Conditions		
Date =	2/1/01	
Shut-In Pressure (psig) from Most Recent Survey =	MD	psig
	50	33
	500	33
	800	63.6
	1000	84
	1500	225
	2000	367
	2500	537
	3000	705
	3500	856
	4000	994
	4600	1157
	4700	1194.1
KB Height Above Ground Level (ft) =	25.0	



PUNA GEOTHERMAL VENTURE
HAWAII

Proposed KS-10 Injection Test

9 May, 2001

R. F. Brady

Deputy
CWRM Deputy
Fiscal / DP
Personnel
BOC
BOR
CWRM
HP
KIRC
Land
Parks
PIO

37989

RECEIVED
01 APR 20 A11 : 56
DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O.BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD/SDWB

April 12, 2001

Mr. Barry T. Mizuno
Owner's Representative
Puna Geothermal Venture
P.O. Box 30
Pahoa, Hawaii 96778

Dear Mr. Mizuno:

SUBJECT: PUNA GEOTHERMAL VENTURE
UNDERGROUND INJECTION CONTROL (UIC)
STATE UIC PERMIT NO. UH-1529

The Department of Health hereby issues to you an administrative extension for State UIC Permit No. UH-1529 until October 20, 2001, or until a renewal permit is issued, whichever occurs first. Until the permit renewal process is completed, you are to act in accordance with the existing UIC permit in concert with interim approvals that have been previously granted and which concurrently run with this administrative extension.

If you have any questions about this subject, please contact William Wong of the Safe Drinking Water Branch (SDWB) at 586-4258 (Honolulu) or call from Big Island the direct toll free number 974-4000, ext. 64258.

'01 APR 24 PM01:16 WATER & LAND

Sincerely,

GARY GILL, DEPUTY DIRECTOR
Environmental Health Administration

CH:chl

c: 1. Glenn Tomori, SDWB Sanitarian, Hilo
2. Mr. Christopher Yuen, Director, Planning Department, Hawaii County
3. Mr. Gil S. Coloma-Agaran, Chairman, DLNR
4. Dr. Seiji Naya, Director, DBEDT
5. Ms. Laura Tom Bose, Chief, Ground Water Office, EPA

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

Gilbert Coloma-Agaran, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
JANET E. KAWELO

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LAND DIVISION
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TECHNICAL & SUPPORT BRANCH
STATE PARKS
WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

March 7, 2001

To: Andrew Monden, Chief Engineer
Engineering Branch, Honolulu

From: Eric Tanaka
Engineering Branch, Hilo

Re: Confirmation letter for the approval use of Injection Well KS-1A from EPA and DOH

Attached are copies of the two letters confirming the verbal approval of the use of Injection Well KS-1A at the Puna Geothermal Ventures development by the Environmental Protection Agency and The Department of Health. The approval for the use of the well is for a period of two (2) weeks to do testing of Production Well KS-11. As stated in the letters the purpose for the flow testing of the well KS-11 is to acquire information to improve the efficiency of the operations.

If there are any questions to any of the above and attached, please feel free to call on me at any time.

Mahalo,

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

March 6, 2001

Mr. Chauncey Hew, Clean Water Branch
Hawaii Department of Health
P.O. Box 3378
Honolulu, HI 96801

Dear Mr. Hew:

Pursuant to our phone conversation held earlier today, Puna Geothermal Venture (PGV) requests approval from the Hawaii Department of Health, Clean Water Branch, to use injection well KS-1A between March 7 and ending no later than March 21, 2001 for equipment testing and fluid sampling data collection.

The equipment testing consists of taking fluid samples from our new separator vessel, and several other locations under normal operating conditions. As discussed, PGV's new separator was modified to improve the vessels separation efficiency, which previously caused operational problems. Hopefully, the results will confirm proper performance of the new separator. The fluid sampling data collection planned is for PGV to be able to collect data and analyze the chemical composition of production well KS-11, and to assist PGV in formulating a plan to address scale formation issues within the piping.

During this approximate two-week period, PGV will have continuous monitoring on the nitrogen annular pressure. PGV will maintain a minimum of 300-psig nitrogen pressure in the annulus. This minimum nitrogen pressure correlates to suppression of the water level to 1,500 feet KB. Please note that previous diagnostic testing performed on KS-1A confirmed that mechanical integrity of the 7" casing is satisfactory to a minimum depth of 3000 feet KB. This test was confirmed by pressurizing both the annular space between the 5" liner & 7" casing, and the inside of the 5" liner to ~1330 psig, with no obvious decrease in pressure over a five hour period.

Thank you for consideration of our requests. If there are any questions, then please do not hesitate to call me at 808-965-6233 ext. 238

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Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

Sincerely,

Michael L Kaleikini

Michael L Kaleikini
Plant Manager

cc: Mr. Eric Tanaka, DLNR
Ms. Shannon FitzGerald, EPA Region IX
Mr. Darren Hunt - PGV

T:\btm\corres.out\doh\010306.doc

Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE
HAWAII

March 6, 2001

Ms. Shannon FitzGerald
U.S. Environmental Protection Agency, Region IX
Ground Water Office WTR-9
75 Hawthorne Street
San Francisco, California 94105

Dear Ms. FitzGerald:

Pursuant to our phone conversation held earlier today, Puna Geothermal Venture (PGV) requests approval from the U.S. Environmental Protection Agency (EPA), Region IX to use injection well KS-1A between March 7 and ending no later than March 21, 2001 for equipment testing and fluid sampling data collection.

The equipment testing consists of taking fluid samples from our new separator vessel, and several other locations under normal operating conditions. As discussed, PGV's new separator was modified to improve the vessels separation efficiency, which previously caused operational problems. Hopefully, the results will confirm proper performance of the new separator. The fluid sampling data collection planned is for PGV to be able to collect data and analyze the chemical composition of production well KS-11, and to assist PGV in formulating a plan to address scale formation issues within the piping.

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Thank you for consideration of our requests. If there are any questions, then please do not hesitate to call me at 808-965-6233 ext. 238

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Post Office Box 30
14-3860 Kapoho Pahoa Rd.
Pahoa, Hawaii 96778
Telephone (808) 965-6233
Facsimile (808) 965-7254

PUNA
GEOTHERMAL VENTURE

HAWAII

Sincerely,

Michael L Kaleikini

Michael L Kaleikini
Plant Manager

cc: Mr. Eric Tanaka, DLNR
Mr. Chauncey Hew, HDOH
Mr. Darren Hunt - PGV

T:\btm\corres.out\federal\010305.doc